INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES

FYGL BULLETIN NO. 4

PTEMBER 1972

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UNITED STATES

DEPARTMENT OF COMMERCE

DEPARTMENT OF DEFENSE

DEPARTMENT OF INTERIOR

DEPARTMENT OF TRANSPORTATION

ENVIRONMENTAL PROTECTION AGENCY

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ONTARIO MINISTRY OF THE ENVIRONMENT

ONTARIO MINISTRY OF NATURAL RESOURCES

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CANADA

Editor	Joseph MacDowall
Arrangement and Layout	Barbara Farnworth
Typing	Alix O'Hara

Editor's Note

Within the pages of this section of the Bulletin we are attempting to give an accurate, succinct, and up-to-date account of the IFYGL in Canada. Numbers 1 and 2 mostly dealt with our organisation and plans, and in Number 3 some of the equipment was described. Number 4 is the first issue to give preliminary results together with an account of how closely our ships and aircraft followed the plans. There are still gaps, any contributions which would help fill these gaps would be greatly appreciated.

J. MacDowall
Canada Centre for Inland Waters,
Burlington, Ontario.

September 1972

IFYGL ATMOSPHERIC WATER BALANCE PROJECT

H. L. Ferguson and J. Sandilands

The Atmospheric Water Balance Project is a joint United States - Canadian IFYGL program under the project leadership of E. M. Rasmusson (NOAA U.S.A.) and H. L. Ferguson (AES Canada).

The basic objectives of the project are:

1. To estimate horizontal water vapour flux divergence from the volume of the atmosphere above Lake Ontario using rawinsonde data.

2. To obtain an independent estimate of evaporation from the lake surface.

As an auxiliary product of the project, the momentum and kinetic energy budgets of the lower troposphere will also be investigated.

Feasibility Studies

It had been previously found that studying the atmospheric water budget by rawinsonde methods produces reliable evaporation estimates for polygonal networks over areas of about 0.1 Mm^2 or larger and time spans ranging from one month to one week. With the above-noted limitations, the method was less successful when applied to an area the size of Lake Ontario and time periods of one month or less. This deterioration of results, as small areas are considered, has been documented by Rasmusson (1968) and is shown in Table 1.

It was because of these limitations that the need for feasibility studies arose, since Lake Ontario, with an area of 0.019 Mm^2 is considerably below the area of 2 Mm^2 suggested as the lower limit of reliability by Rasmusson. It was also considered desirable to obtain evaporation estimates for time periods of less than one month.

In addition to the above problems the significance of lake breeze circulations needed to be studied along with the height to which soundings should ascend in the atmosphere.

With these problems in mind, three feasibility studies were carried out beginning in 1968.

Feasibility Study #1

The first feasibility study (Ferguson and O'Neill 1968) was an empirical study based on standard data from three network rawinsonde stations in the northeastern United States. In addition, the moisture flux divergence implications of a hypothetical lake breeze circulation were examined.

TABLE 1. A summary of studies using the atmospheric water balance to obtain evaporation estimated over areas less than 1 Mm^2.

Author or project	Area (Mm^2) and Location	Stations	Data Sfc to	Data Pressure Interval	Time interval	Remarks
Hutchings (1957)	0.09 Great Britain	4	500mb	p = 50mb	12 hr	Reasonable E for one to three months.
Nyberg (1965)	0.07 Southern Sweden	6	500mb	Standard level	12 hr	Annual E and march of Monthly E reasonable in comparison with hydrologic data. Geostrophic method acceptable most months.
Palmén and Soderman (1966)	0.34 Baltic	6	400mb	Standard level	12 hr	Realistic monthly values of E. Use of geostrophic winds over estimated E.
Soderman and Wasentera (1966)	0.247 Finland	5	400mb	Standard level	12 hr	Monthly values of E fair to good. Geostrophic approximation not as good as actual.
Ferguson and O'Neill (1968)	0.03 Northeastern U.S.	3	350mb	50mb	Monthly mean winds and humidities based on 12 hourly data	Monthly estimates of E generally poor. Monthly mean geostrophic winds grossly under estimated E.
Rasmusson (1971)	0.02 Great Lakes 0.73 Great Lakes Basin 0.53 Ohio Basin	U/A Network	400mb	50mb	12 hr	Monthly values of E fair to good.
Bomex	0.25 Carribean	4 (ships)	500mb	25mb	1.5 to 6 hr	Dropsondes also used. Results not yet available.
IFYGL (tentative)	0.019 Lake Ontario	6	400mb	25mb	2 hr	

The purposes of the study were as follows:

1. To examine the atmospheric water balance as applied to a small area (.03 Mm^2) not far from Lake Ontario.

2. To compare the use of geostrophic and real winds.

3. To estimate the relative magnitude of the mean monthly and eddy moisture divergence from the water balance equation.

4. To study vertical profiles of mean monthly moisture flux divergence.

5. To study the moisture flux divergence effects of an assumed lake breeze effect.

From this study it was found that geostrophic winds lead to unreasonable flux divergence values. Real winds can, in some cases, produce realistic values but, in general, eddy terms, ignored here, appear to be of the same order of magnitude as the mean moisture flux divergence terms.

Secondly, the hypothetical lake breeze studied was found to make a significant contribution to monthly values of vertically integrated moisture flux divergence.

At this point it was concluded that the method could be applied over an area the size of Lake Ontario only if special effort was made to define the profiles of wind and moisture in the lower layers of the atmosphere.

Feasibility Study # 2

The second feasibility study (O'Neill and Ferguson 1971) involved a power spectral density analysis of specific humidity, wind components and vapour flux components from a series of hourly rawinsonde flights. The purposes of this study were as follows:

1. To aid in the rational selection of sampling intervals in time.

2. To examine, by means of a power spectral density analysis, the internal variability of a time series of rawinsonde measurements.

3. To obtain estimates of aliasing error as a function of sampling interval.

4. To obtain the best compromise between accuracy and cost, as well as a more meaningful interpretation of the results.

The results of the study showed that short term moisture fluctuations were important and that errors in estimates of the vertically integrated flux may be lowered by 50% if the sampling interval is reduced from 12 to 2 hours.

Feasibility Study #3

The purposes of third feasibility study were as follows:

1. To test linear interpolation of the moisture, wind and the moisture flux between the end points of a line approximating the network spacing of IFYGL.

2. To examine at least one method of semi-automated data reduction.

3. To obtain at least partial knowledge of the logistics and operational aspects of rawinsonde flights taken every 2 hours.

4. To assess any significant operational differences between the cooperating agencies.

From the results of this study, it was found that for the moisture flux divergence there was a departure from perfect linear fit of the data. This departure was about 6%. A similar bias, although less pronounced, appeared in the total vapour flux. It would, therefore, appear that linear interpolatio of moisture flux would lead to only a small error over a baseline of this length (54 km). Unfortunately some of the IFYGL baselines are considerably longer and interpolation errors may still be a problem.

Present Status

The decision has been made to use a version of the Loran-C Locate System primarily because of the improved accuracy of the data collected by the system. The rawinsonde systems presently used by the Canadian and United States weather services cannot collect data with sufficient degree of accuracy necessary for this project.

The ground equipment used will be a version of the Loran-C Locate Navaid Integrated Upper Air Sounding System manufactured by Beukers Laboratories Inc., Hauppage, New York. The outside ground equipment consists of an omnidirectional antenna for local Loran-C reception, a corner-reflector telemetry receiver (directional) with a remote indoor antenna rotator and telemetry preamplifier. Indoor equipment consists of the telemetry receiver, meteorological and Loran-C processors, oscilloscope, Loran recorder, digital interface unit, central processor, met data recorder, magnetic tape transport and its interface unit and a teletype printer-reader.

The radiosonde will be an Automet Sonde, Model 1223, made by VIZ Manufacturing Co. of Philadelphia. The following performance (system RMS error) is expected of the integrated system.

Winds	-	RMS Vector error +0.5 mps for 1 minute averages
Temperature	-	+0.2 degrees C RMS
Humidity	-	+5% R.H. RMS
Pressure	-	+1 millibar RMS

Six rawinsonde stations (shown on Figure 1) will be set up around the lake perimeter for this project. The observational flights will be carried out concurrently at each station as shown in the table below:

2 flights per day (00 and 12Z)	8 flights per day
Sept. 16 - 19	Sept. 20 - 24
Sept. 25 - Oct. 1	Oct. 2 - 18
Oct. 19 - 29	Oct. 30 - Nov. 14
Nov. 15 - 20	Nov. 21 - Dec. 7

In addition flights made at 03Z, 09Z, 15Z, and 21Z will be downtracked during the periods when 8 flights per day are undertaken.

Data processing will be carried out at CEDDA (Centre for Experimental Design and Data Analysis), Rockville, Maryland. As well as the regular analysis for moisture flux, heat and momentum balance analyses will also be carried out. All data will be analysed over several time intervals.

Several problems remain as far as gathering sufficient data for a complete project analysis. For example, more data are needed for the computation of condensed water flux divergence. To help solve this problem data will be used from all available sources such as the all-sky photographs, aircraft and satellite photographs, precipitation-radar data and synoptic meteorological reports.

The other problem is to collect sufficient low level data. To help with the problem all meteorological data from the lake towers and the shoreline stations will be incorporated into the analysis.

In summary, the IFYGL Water Balance Project is a scientifically exciting undertaking, which, even if only partially successful, will add much to man's knowledge of the physical response of the atmosphere as it passes over a large lake.

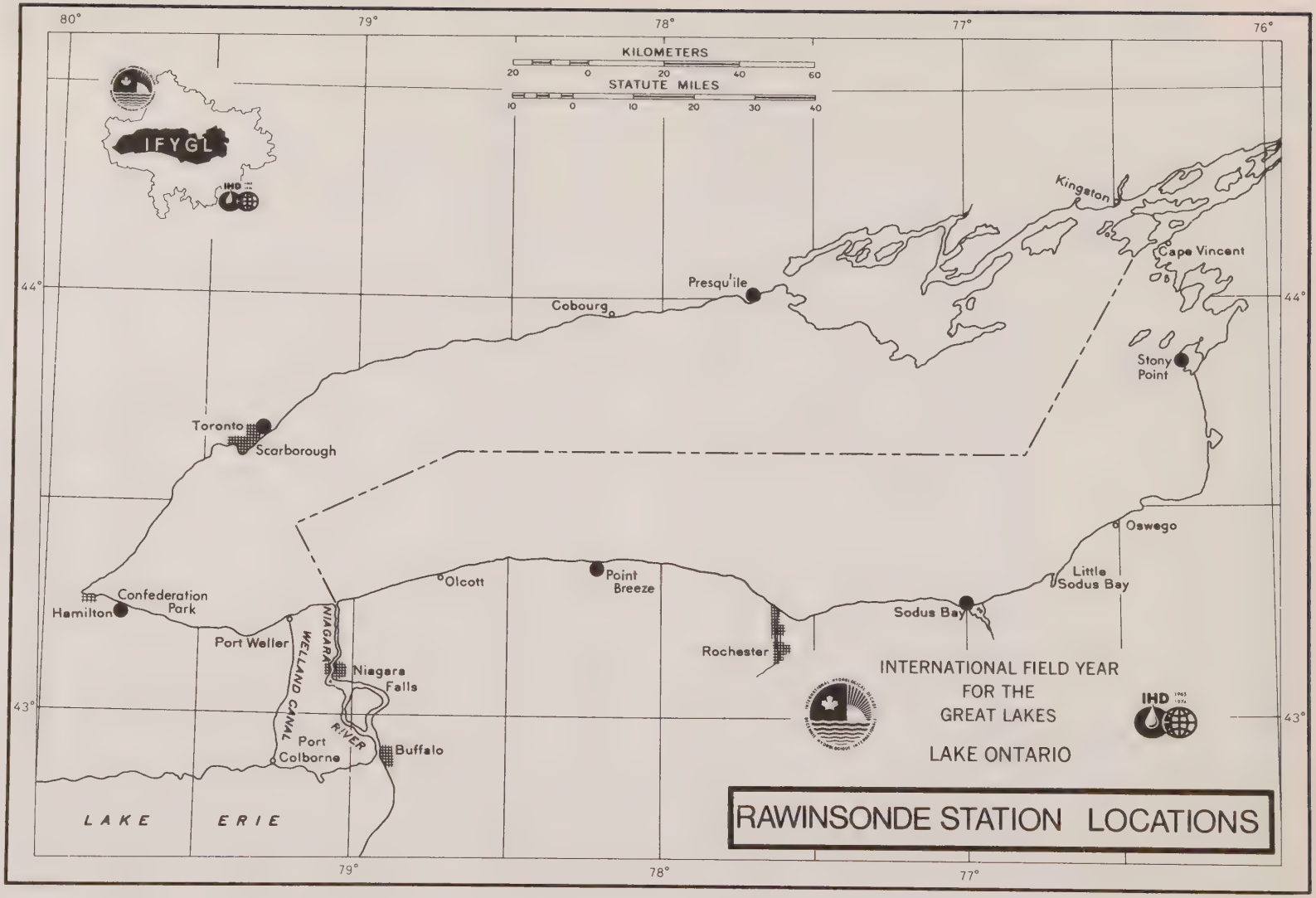

Figure 1. Positions of rawinsonde stations used for atmospheric water balance study.

REMOTE SENSING

K. P. B. Thomson

Introduction

Most of the Canadian projects that come under the "sphere of influence" of remote sensing have been generated by user agencies in cooperation with the Canada Centre for Remote Sensing (CCRS). In these cases the user agencies supply the expertise in interpretation while the CCRS in Ottawa provides the aircraft and the sensor packages.

The Status of Canadian Projects

The following is a brief account of the status of each project as of July 31, 1972. The IFYGL designation, the principal agency, and the principal investigator will be given in each case.

1. *IFYGL Project 1F*
   Principal Agency - Canada Centre for Inland Waters
   Principal Investigator - K. P. B. Thomson

   (a) Low Level IR Surveys:

   The first phase of this experiment was carried out during the month of May. Severe fog conditions on Lake Ontario made data collection difficult and at times impossible. However, relatively good imagery was obtained on the following days: May 11, 18, 19 and 29.

   The sensor package flown in the Airborne Sensing Unit's Dakota contained a Daedalus line scanner, PRT-5 radiometer, and two Vinten Cameras. Measurements of lake surface temperature and bathythermographs were obtained by a CCIW launch during each aircraft survey.

   (b) High Level Scanner Survey:

   The first phase of the high altitude survey of Lake Ontario was carried out by the CCRS Falcon aircraft on June 7, 1972. Unfortunately, only part of the project was completed due to poor weather conditions.

   The Atmospheric Environment Service airborne radiometer survey was able to merge its operation to coincide with the over-flight.

(c) Aerial Photography for Coastal Diffusion Studies:

A number of missions have been carried out near Oshawa in support of the Turbulent Diffusion Studies project (89 and 90 WM) using an aircraft on charter to CCIW. The aircraft, a Piper Comanchee, is equipped with two Hasselblad 70 mm cameras, a PRT-5 radiation thermometer, as well as humidity and air temperature sensors.

Some initial tests of the PRT-5 and complemenetary atmospheric sensors were carried out during the May alert period at the Air-Water interaction study site 2 km offshore near Niagara-on-the-Lake. It is hoped that some other flights of this nature can be made during other alert periods.

2. *IFYGL Project 84BC*
Principal Agency - Ontario Ministry of the Environment
Principal Investigator - G. Owen

A number of photographic surveys have been carried out by CCRS aircraft over selected areas of the north shore of Lake Ontario as part of the Cladophora program. The flights were completed on June 5, 9, and July 5, 1972.

The writer has recently seen some examples of the photography and they appear to be of exceptional quality. They should provide a useful data source for this important project.

During the photographic missions it is planned to undertake tests of some new remote sensing devices. The first test, using the SPAR image intensifier tube, was carried out on the July 5 missions.

The University of Michigan also plan to fly their multispectral scanner at some time during the cladophora survey.

3. *IFYGL Project 70 WM*
Principal Agency - Centre for Applied Research, McMaster University
Principal Investigator - A. Falconer

This project involves a number of agencies in the western Lake Ontario basin. For example, the Universities of Guelph and McMaster, as well as Provincial and Federal Government departments.

The photographic overflights of the western Lake Ontario basin, by a NASA RB57 aircraft, occurred on June 5 and 7. The multispectral photography should be available for anlysis in approximately 6 weeks from the time of the overflight.

4. *IFYGL Project 94*
Principal Agency - Canada Centre for Inland Waters
Principal Investigator - H. W. MacPhail

(a) IRLS Data Retransmission Experiment:

This project is a cooperative venture between CCIW and the NASA-LEWIS Research Centre in Cleveland, Ohio. The experiment will utilize the data retransmission facility of the NIMBUS IV satellite to track a buoy floating freely in Lake Ontario.

The IRLS interrogation package and the buoy have been provided by the NASA-LEWIS Research Centre, while CCIW has undertaken to provide a major ship to release and service the buoy. Mr. R. I. Jirberg is the principal cooperating scientist for the NASA-LEWIS Centre.

The buoy (Figure 2)was released on July 17, in center of Lake Ontario. The NIMBUS IV satellite interrogates the buoy once every 12 hours and relays its positions as well as readings of air temperature and water temperature (at a depth of 2 metres). See Figure 3 for buoy positions.

It is hoped that this experiment will lead to information on near surface circulations in Lake Ontario.

(b) ERTS DCP Experiment:

Now that ERTS is "safely aloft" the second data retransmission experiment will commence at the beginning of August.

Air temperature, humidity, and water temperature will be relayed from a moored buoy via the ERTS data retransmission facility. After initial tests at CCIW the buoy will be moved to the Niagara IFYGL test site. The buoy is expected to operate for 3 months without attention and the plan is to keep it in operation until December 1, 1972.

Figure 2. Free drifting buoy used for the NIMBUS satellite retransmission experiment.

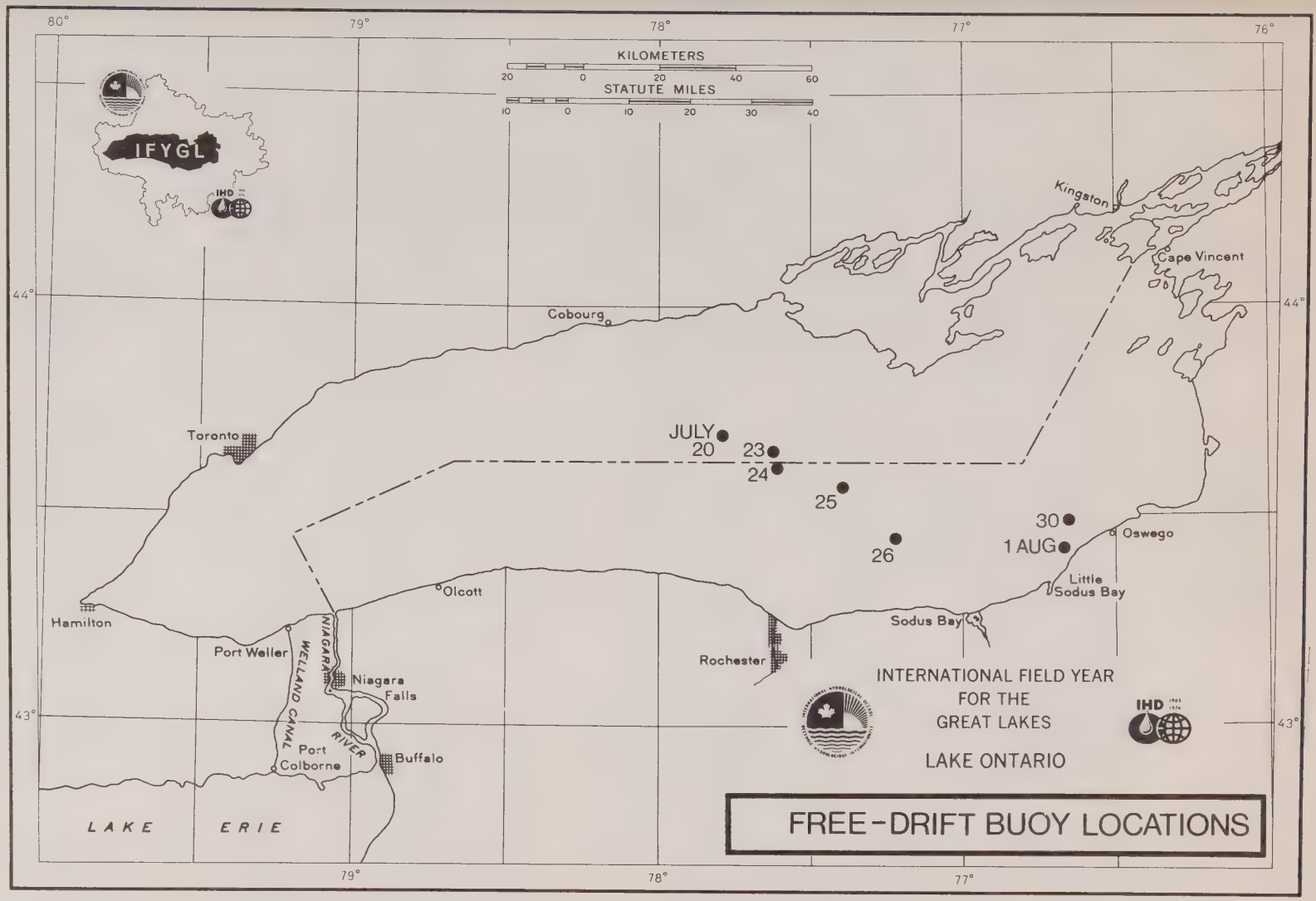

Figure 3. The locations reported by NIMBUS IV of the freely drifting buoy.

PROJECT OOPS

W. Glooschenko

Project OOPS is an acronym for the Ontario Organic Particle Study. This Canada Centre for Inland Waters project was initially conceived as an IFYGL study of organic particles, both living and non-living (detrital); however, chemical studies of dissolved and particulate inorganic elements were added onto the study. Thus OOPS can be considered an integrated biological-chemical study of the lake with particular emphasis upon biological processes and their interaction with chemical processes.

OOPS consists of a series of nine two-week cruises. The first five day week is entitled Phase I, while the second five day week is entitled Phase II. Approximate cruise dates are as follows: April 10 - 27, May 23 - 31, June 10 - July 1, July 17 - 29, September 5 - 16, October 16 - 28, November 20 - December 2, 1972 and January 8 - 20, March 5 - 17, 1973. Phase I consists of sampling on 32 stations located on 4 north-south transects (Figure 4), while Phase II is limited to 2 stations (Figure 5), occupied for 48 hours each. The second phase was chosen mainly to study biological and chemical processes that exhibit temporal variations. Mr. M. Shiomi of the Biogeochemical Limnology Subdivision, Lakes Research Division, CCIW, is Chief Scientist of Phase I, while Dr. W. A. Glooschenko, Fisheries Research Board Detachment, CCIW, is in charge of Phase II studies.

Chemical Aspects, Phase I

The main chemical program carried out during OOPS cruises is designed to further our knowledge of the spatial and temporal distribution of important chemical parameters in Lake Ontario waters. The distribution of these chemical parameters is being studied in relation to three physical phenomena that occur in Lake Ontario during the year, the development of the thermal bar in spring and early summer, the stratification of the lake waters during the summer and over-turn and mixing of the lake in the late fall. The information gained from this study, besides extending and complementing existing knowledge of chemical processes in the lake, will be useful input to those formulating water management policies for the Lake Ontario Basin.

This chemical investigation is concentrating on the following chemical parameters:

Carbon	- particulate organic carbon, total filtered alkalinity
Nitrogen	- nitrite + nitrate, ammonia, total soluble phosphorus, total phosphorus
Silica	- soluble reactive silica
Iron	- soluble iron
Manganese	- soluble manganese, total manganese
Chloride ion	

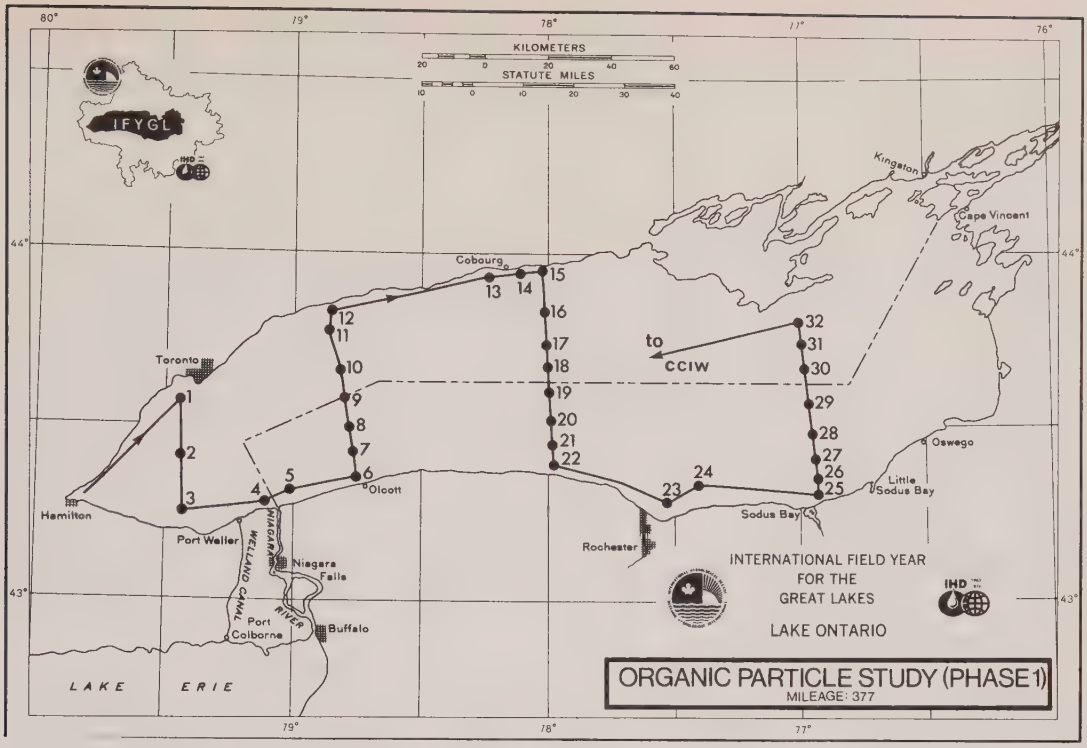

Figure 4. Cruise track of Phase I of each OOPS cruise.

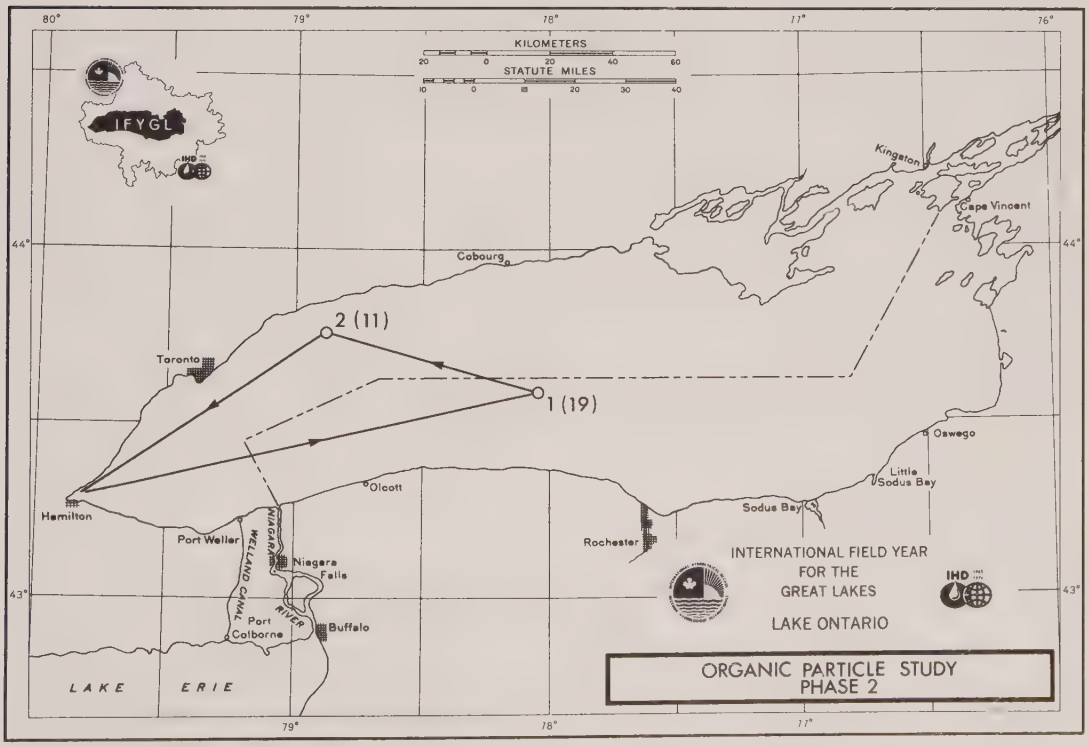

Figure 5. Cruise track of Phase II of each OOPS cruise.

Thirty-two (32) stations located along four north-south transects are being sampled during each OOPS chemical cruise, which takes about 5 days to complete. The number of depths sampled at each station depends upon the temperature structure of the water column at the time of the cruise and the depth of the lake at the station.

All the chemical analyses listed, with the exception of the iron and manganese analyses, are performed on all depth samples from all stations. The iron and manganese analyses are done only on samples from 12 of the 32 stations.

Two other more specialized chemical studies are being carried out in conjunction with the IFYGL OOPS chemical cruises. During each cruise one station, located in the middle of the lake, is occupied for a 24-hour period in order to carry out the experimental work for these special studies.

One of these studies is investigating carbon dioxide in the air over Lake Ontario, determining the seasonal and diurnal variation of the CO_2 partial pressure in the air above the lake and in the lake water. Carbon dioxide is an important geochemical parameter and it is important to determine whether the lake acts as a source or sink for it.

The CO_2 in the air is sampled twice every hour during the 24-hour period on station at two levels: shipmast height and as close to the lake surface as possible. Lake water samples are taken at four depths, from the surface to just below the thermocline, every 12 hours. The CO_2 in the air is measured by a non-dispersive IR analyser. The CO_2 in the lake water is measured by gas chromatography, the carbonate alkalinity by titration and the pH by electrode.

The other special chemical investigation, the study of organic particle settling in Lake Ontario, is intended to quantify, if possible, the transfer of nutrient elements by the settling process from the upper layer (epilimnion) to the lower layer (hypolimnion) during the stratified period. Experiments on community productivity are being carried out simultaneously with the settling experiments and observation of changes in the concentration profile of organic particles. It is hoped that the combination of information on the three processes, settling fluxes, community productivity and concentration, will lead to an estimation of the coefficient of turbulent diffusion between the horizontal layers. This will then lead to a more complete description of the exchange processes between the epilimnion and hypolimnion by considering settling, change of depth of thermocline and vertical diffusion.

Biological Aspects - Phase I and II

Biological studies during Phase I are designed to study spatial aspects of plankton in Lake Ontario. In terms of phytoplankton, chlorophyll *a* samples are taken on all stations (Figure 4) at selected depths to 40 meters to determine both the vertical and horizontal distribution of phytoplankton. Complementing this at selected stations are preserved samples for identification and enumeration of phytoplankton. Vertical net hauls on all stations are made also to determine biomass and species compostion of zooplankton. Also, special samples are taken for the study of *Mysis* in the lake, an

important species in food webs.

The major purpose of biological research on Phase II of OOPS is the study of temporal variations of biological parameters, primary production, chlorophyll and zooplankton. To accomplish this, an inshore station (1, Figure 5) and a mid-lake station (2, Figure 5) are occupied for 48 hours.

Primary production is measured by the carbon-14 method for 2-4 hour intervals between sunrise and sunset at various depths to 20 meters. *In situ* and incubator experiments are also made using 0-10 meter integrated samples to compare these two techniques of primary production measurements. The measured assimilation rates will be compared to the concentration of particulate carbon, nitrogen, and phosphorous which are sampled every four hours at selected depths. Also, the question of how much of the particulate organic matter is living or detrital will be investigated by determination of ATP (adenosine triphosphate). Using these different chemical methods for biomass estimation the production/biomass quotient can be determined. Measurements of radiant energy by pyrheliometer and *in situ* quantum photometer are made to determine the influence of light in primary production.

Chlorophyll *a* samples are taken every 2 hours from 2-4 depths. This is used to determine the diel (24 hour time period) variations of this important plant pigment, and to investigate chlorophyll-primary production relationships. Cell samples are also collected for species identification and enumeration to see if any changes in phytoplankton species and numbers occur over the time period studied.

Zooplankton vertical migration is studied by means of vertical closing net hauls at selected depth intervals approximately every four hours. *Mysis* samples are also collected during this phase.

REPORT ON IFYGL INTERCOMPARISON STUDY

H. B. Macdonald

Background

On April 28, it was recommended by the U.S. Joint Management Team by way of a letter from Dr. E. J. Aubert, the U.S. Co-Chairman, that an intercomparison study of the Data Acquisition Systems on the major IFYGL vessels be undertaken. With the acceptance of this proposal on May 16 by the Canadian Joint Management Team, various individuals were assigned the task of working out the details to meet the suggested date of June 26, Mr. H. B. Macdonald, Head, Technical Operations Subdivision CCIW, was to co-ordinate the Chemistry and Biology, and Mr. J. A. W. McCulloch, AES, was assigned the Physical Limnology and Meteorology. Dr. A. Robertson of the U.S. IFYGL Project Office was to act as the U.S. Co-ordinator.

Meteorological and Radiation Data Comparison

During the weekend of June 24, all the ships (MV Martin Karlsen, CSS Limnos, Advance II, Researcher and Porte Dauphine) were tied up alongside at CCIW. They were requested to operate all their radiation and meteorological continuous recording systems. The radiation data collected were to be compared with measurements made on the roof of the laboratory by standard instruments provided by AES, National Atmospheric Radiation Centre. The CCIW instruments were also included in the radiation comparison. In preparation for the Study, Engineering Systems at CCIW checked, calibrated, and monitored the various systems aboard the Canadian vessels. The wind conditions at the dock were not suitable for obtaining any valid comparison of meteorological measurements.

On June 26, the ships departed CCIW at approximately half hour intervals (see Figure 6 for track plots). En route to the designated sampling area (see CCIW cruise reports), each ship passed the AES Bedford Tower on upwind, crosswind, and downwind headings. While in the tower vicinity, observers were required to make and record manual weather observations. The automatic recording systems will provide meteorological data for comparison with tower measured data. In addition, a trained meteorological observer at the tower site made observations for comparison with the manual observations. Upon completion of this phase of the operation, Limnos and Advance II proceeded to locations near the sampling area to obtain EBT traces, then broke off from the exercise to continue with their normal routine for that week.

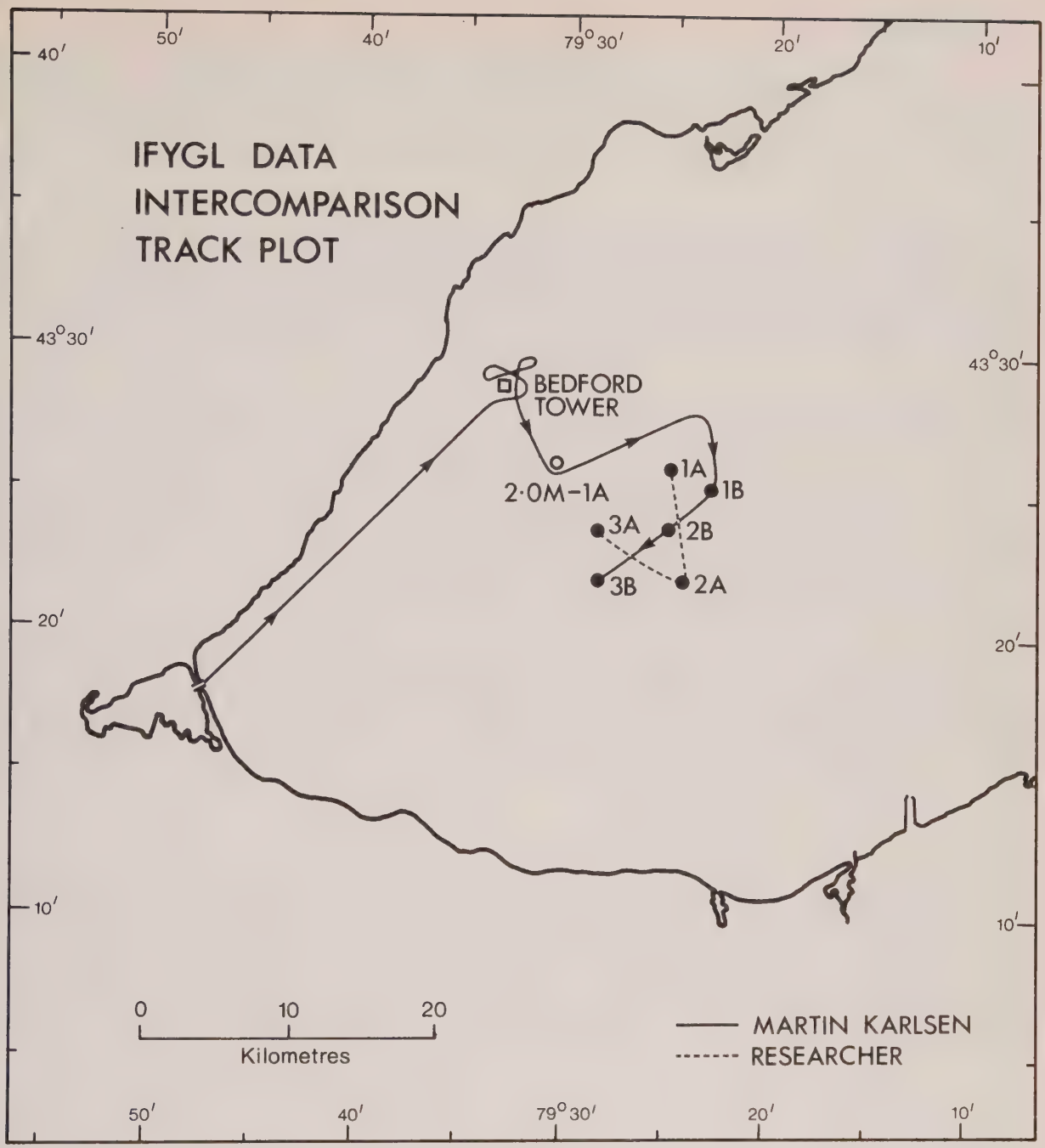

Figure 6. Track plot of major vessels during June 26, 1972, intercomparison trials.

Chemical Comparison

The two ships, Researcher and Martin Karlsen, from which the major chemical sampling program was conducted, carried out coincident sampling at three stations. Sampling depths were determined from the depth-temperature profiles taken by the MV Lac Erie in the designated sampling area prior to any large ship disturbances.

Three sets of samples were obtained at four depths at each of the three stations by both ships. These were distributed immediately to personnel of NOAA, CCIW, and Ontario MOE for preparation and analysis by the techniques normally employed by these agencies. EBT soundings were also determined by the survey done by the Lac Erie.

Water Temperature Structure

Prior to the departure of the major vessels from CCIW, the Lac Erie proceeded to the designated sampling area to determine the thermocline depth and time stability of the water temperature structure under undisturbed conditions. Sampling depths were determined from the temperature structure at this time and transmitted back to the Researcher and Martin Karlsen.

During the chemical sampling, the Lac Erie circled each of the two major ships towing the "fish" (SBT) and taking EBT traces at various distances on the leeward and windward sides of the vessels to determine how much the presence of the ship had disturbed the water. As stated above, these will be compared with the EBT traces taken by the ships.

Data

The radiation data have been supplied to Mr. R. Latimer for evaluation. The meteorological data -- both manual observations for the period when the ships were near the Bedford Tower and the values extracted from the continuous recorders for the same time -- have been sent to Mr. J. A. W. McCulloch, AES. All the chemical data, as they become available, are being turned over to Mr. M. Shiomi for evaluation. The EBT data are being turned over to Mr. F. Boyce.

Summary

While it is difficult (at present) to determine the usefulness of this intercomparison study from the scientific standpoint until all the data have been received and evaluated, operationally it was very successful. Excellent cooperation was enjoyed with all agencies concerned and all manoeuvres and operations proceeded smoothly. More details of the cruises and parameters measured are included in Cruise Reports, 72-22-033, 72-22-034, 72-22-035 produced by Technical Operations Subdivision, CCIW.

THE CCIW NIAGARA BAR MICROMETEOROLOGICAL PROJECT

M. Donelan

The primary objective of this program, the measurement of the vertical fluxes of momentum, heat and moisture by "profile" and "eddy correlation" techniques has been realized under a variety of wind speeds and generally positive atmospheric boundary layer stabilities. It is expected that a corresponding quantity of data will be collected under unstable (negative stability) conditions during the final intensive period in October.

The following table summarizes the operational periods of the mean profiling sub-system (see IFYGL Bulletin No. 3, pages 10 - 11 for a description of the three sub-systems mentioned herein).

Table 2. Operational periods of profiling subsystem

Description	Continuous Operation From	To
Five levels of mean wind and temperature	19/5/72	27/5/72
	13/6/72	18/6/72
	20/6/72	26/6/72
Five levels of mean wind, temperature and relative humidity	18/8/72	5/9/72

The Integrated Flux sub-system was not fully operational until 22/8/72. It will be in continuous operation until October 13, 1972.

There have been 31 successful runs from the Turbulence sub-system. These runs varied in length from 30 minutes to 90 minutes. They are best summarized on a scatter plot of wind speed versus boundary layer stability. Such a diagram is Figure 7 in which the gradient Richardson number is used as the index of stability.

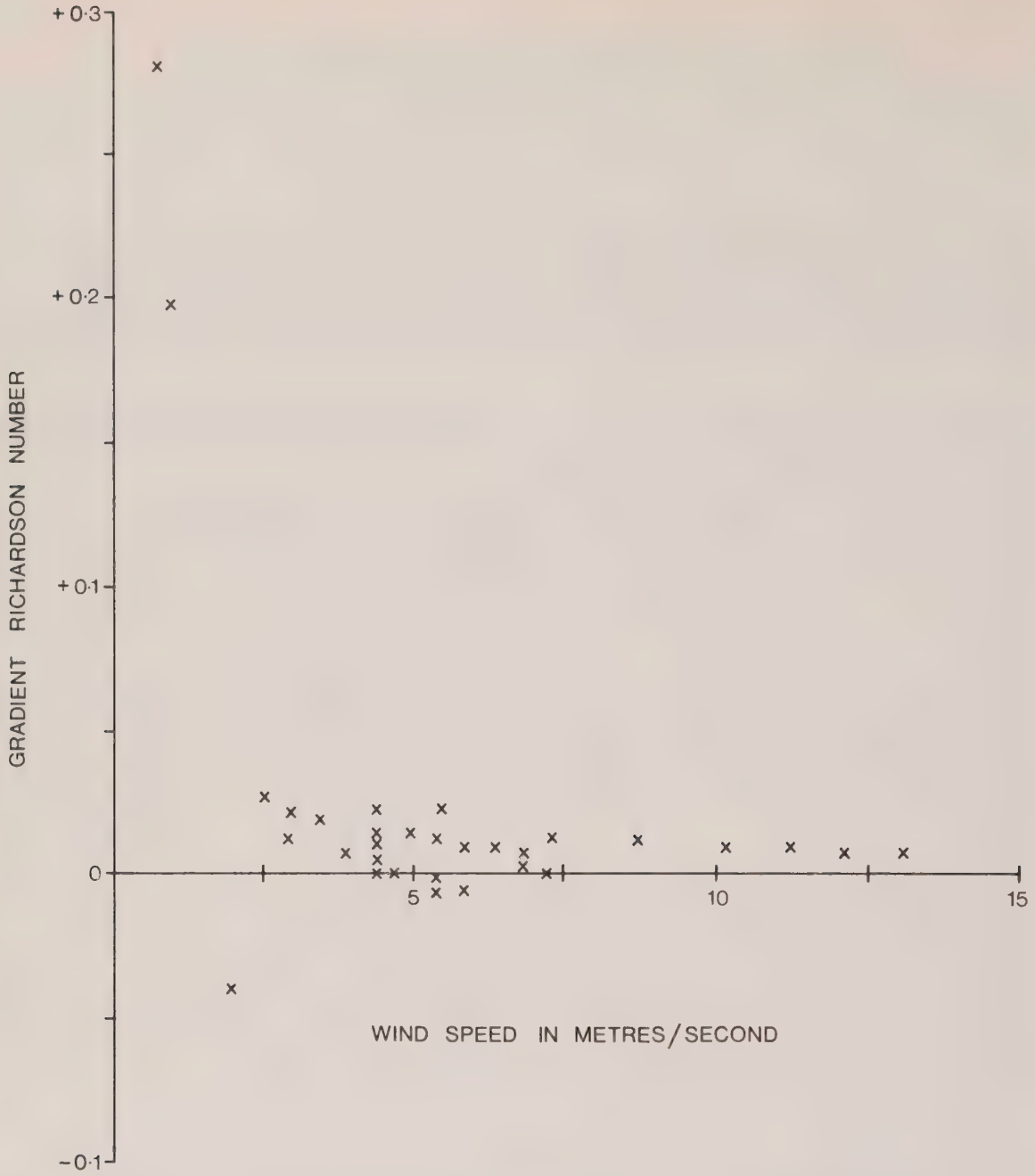

Figure 7. Scatter plot of wind speed vs. boundary layer stability. The measurements were taken as part of the CCIW Micrometeorology project.

WOODBRIDGE RADAR OBSERVING AND DATA PROCESSING SYSTEM

D. M. Pollock

General Description

The Woodbridge Radar is a Curtiss Wright model FPS-1001 C Band radar operated by the Atmospheric Environment Service for research purposes. During IFYGL it will be used for preparing quantitative estimates of precipitation over the northwestern portion of Lake Ontario and its watershed area. The data source for IFYGL will be 35 mm Constant Altitude Plan Position Indicator (CAPPI) photographs which will be processed by the Precipitation Data Integrator (PDI) computer controlled photoscanner and the results stored on 9 channel 31 bits per mm magnetic tape.

Initially one set of 4 CAPPI photographs will be taken every 15 minutes with the approximate altitude of 1.5, 3.7, 5.8 and 7.9 km. Prior to the beginning of the Atmospheric Water Budget program, the CAPPI programmer will be changed so that every 20 minutes a set of 9 photographs will be taken. This set will consist of 3 photographs at the 1.5 km level and 1 photograph at each of 3, 5, 7, 9, 12 and 15 km levels.

Precipitation Data Integrator

The PDI is a computer controlled photoscanner which was developed specifically for the recovery of data from radar photographs. The photoscanner is controlled by a PDP-9 computer with 8K core of 1 microsecond cycle time for 18 bits. The computer has 4 magnetic tape units, a teletype, and high speed paper tape reader-punch.

The computer can position a spot of light on the radar photograph at any point in a 256x256 array. The array can be shifted and expanded or contracted by the computer so that it matches the radar photograph. The density of the film at the selected point is read as a number from 0 - 63 with a standard deviation of less than 1. By comparing the density of the film at the point to a calibration scale on the photograph, the received power from that point can be calculated. The photoscanner will scan about 8000 points per second.

Bowmanville Precipitation Mesonetwork

This network was established in 1970, operates April to November, and will be used only to determine the accuracy with which the radar at Woodbridge, Ontario, measures precipitation. The data will not be used to derive the precipitation measurements for the basin.

The network consists of 12 recording rain gauges of the tipping bucket variety which have a resolution of 0.01 inches (0.25) of rain. The gauges are battery operated and record in ink on a chart. Each gauge is inspected and the charts changed once per week. Hourly rainfall values are abstracted from the charts.

In the vicinity of the network, six ordinary climatological stations were operating with standard gauges prior to 1972 (see Figure 8) and one station (Mostert) with a tipping bucket gauge using one day charts. In addition, streamflow measurements are being taken on the Wilmot, Soper and Bowmanville Creeks and may be used in the analysis.

At location 12, a distrometer and a volumetric type recording rain gauge will be installed in May 1972. This distrometer detects and records each raindrop on punched paper tape. The momentum of each drop is measured and the drop is assigned to one of twenty drop size classes. The smallest size drop which can be detected is 0.3 mm.

Other precipitation gauges also will be used in the error analysis. This will allow an assessment of the accuracy of the precipitation estimates and the dependence of this accuracy on distance from the radar. The largest single group of these other gauges are the nine gauges located between 43° 57' and 44° 07' north latitude and 79° 03' and 79° 16' west longitude near Uxbridge, Ontario. The Woodbridge radar is approximately 32 km from these gauges as compared to the 72 km from the Bowmanville mesonetwork.

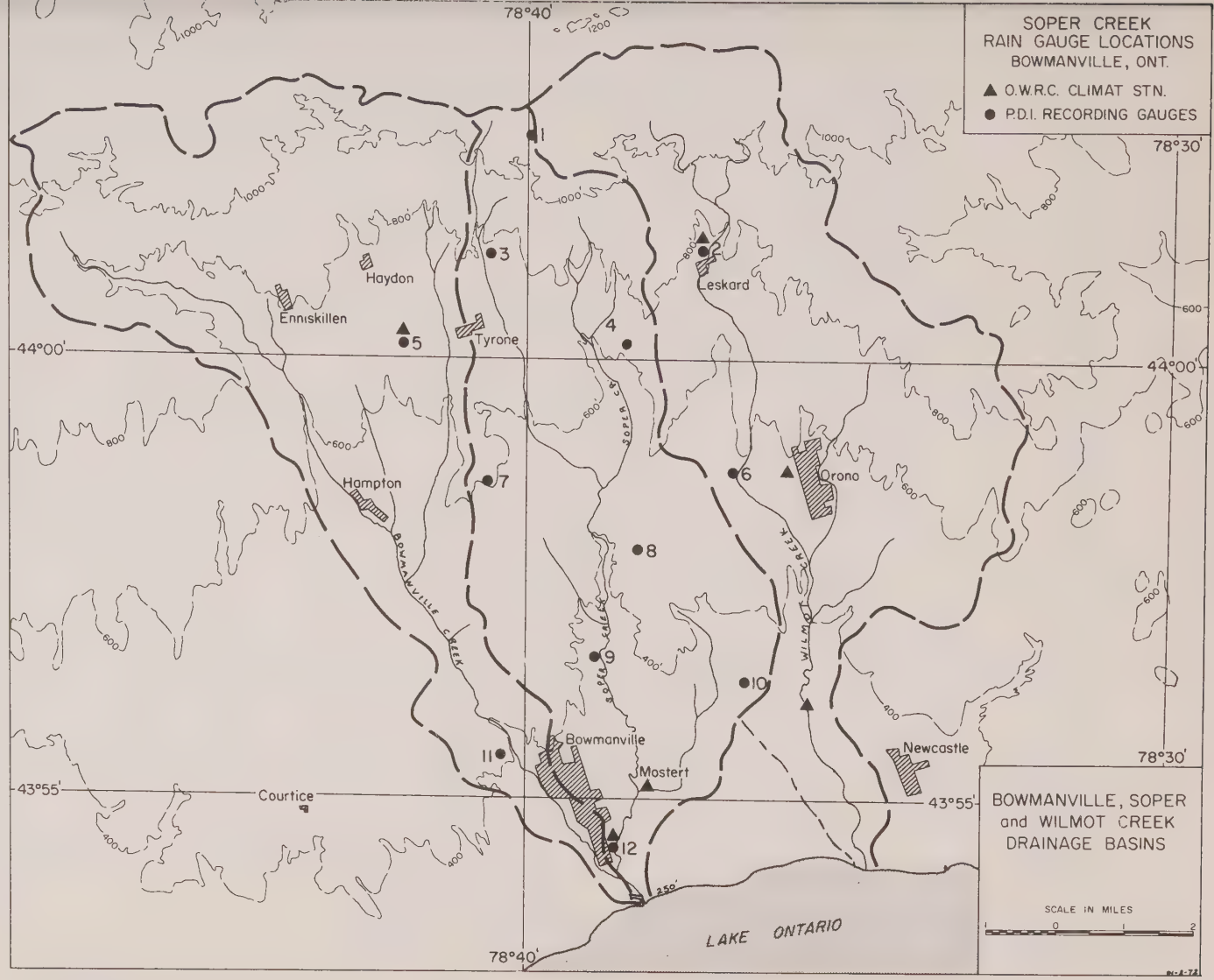

Figure 8. Location of precipitation gauges in Bowmanville precipitation mesonetwork.

LOCATION OF CANADIAN STATIONS

The following is a list of the final locations of Canadian stations. Also shown is a map giving the locations of all radiation meters (see Figure 9.) as well as type of radiation measured.

1. *Decca Reference Buoys (revision to Table 2, Bulletin 3)*

Buoy	Latitude North			Longitude West		
	Deg.	Min.	Sec.	Deg.	Min.	Sec.
5	43	17	39	77	00	39
10	43	55	16	78	13	18
12	43	35	09	79	28	05

2. *Deep Water - Met Buoy Moorings - Instrumentation April 5 - 11 (Stations 1 - 6), April 18 - 25 (Stations 7 - 11)*

Buoy	Latitude North			Longitude West			Water Depth (m)
	Deg.	Min.	Sec.	Deg.	Min.	Sec.	
1	43	25	34	79	30	51	92
2	43	30	53	79	19	01	109
3	43	24	23	79	17	20	114
4	43	17	31	79	07	55	14
5(13)	43	26	03	78	43	40	129
6	43	43	56	78	49	23	84
7	43	38	48	78	29	30	143
8	43	52	00	78	01	30	63
9	43	51	10	77	41	09	68
10	43	39	20	77	42	20	139
11	43	47	28	76	50	31	74

3. *Thermistor Moorings - installed May 15 - 19 (9-11) and April 20 (6)*

Buoy	Latitude North Deg.	Min.	Sec.	Longitude West Deg.	Min.	Sec.	Water Depth (m)
6	43	44	19	78	49	07	80
9	43	49	59	77	40	54	69
10	43	40	24	77	43	05	139
11	43	46	10	76	50	05	79

4. *Deep Water Buoys - Current Meter Moorings: installed May 15 - 19, 1972 (instrument position given)*

Buoy	Latitude North Deg.	Min.	Sec.	Longitude West Deg.	Min.	Sec.	Depth of Meters (m)	Water Depth (m)
2	43	31	00	79	19	23	10,15,30,50	110
3	43	24	28	79	17	31	10,15,30	112
4	43	19	01	79	14	01	10,15,30,50	89
6	43	44	03	78	49	00	10,15,30,50	89
8	43	49	32	78	02	32	10,15,30	72
9	43	50	01	77	40	51	10,15,30,50	69
10	43	40	23	77	43	00	10,15,30,50	138
11	43	46	13	76	49	52	10,15,30,50	79
13	43	26	03	78	43	40	10, 15	127

5. *Dye Barge and Coastal Mooring Floats - installed May 15 - 19, 1972*

Buoy	Latitude North Deg.	Min.	Sec.	Longitude West Deg.	Min.	Sec.	Water Depth (m)
Dye Barge	43	50	53	78	44	06	18
M #1	43	50	53	78	45	18	
M #2	43	50	45	78	46	34	
M #3	43	50	59	78	44	01	

6. *Oshawa Coastal Chain - installed May 15 - 19, 1972*

Buoy	Latitude North Deg.	Min.	Sec.	Longitude West Deg.	Min.	Sec.	Depth of Meters (m)	Water Depth (m)
31	43	50	45	78	50	43		9
32	43	50	31	78	50	50	10	13.5
33	43	50	13	78	50	40		18
34	43	49	59	78	50	33	10	20
35	43	49	40	78	50	29		23
36	43	49	30	78	50	27	10	27
37	43	49	11	78	50	20		31
38	43	48	49	78	50	13	10	33
39	43	48	41	78	50	10		38
40	43	48	07	78	50	09		44
41	43	47	49	78	49	57	10	49
42	43	47	37	78	49	56		50
43	43	47	04	78	49	50		56
44	43	46	32	78	49	40		62
45	43	46	02	78	49	33		68
46	43	44	57	78	49	15		82
47	43	44	10	78	48	50		86

7. *Presqu'ile Coastal Chain - installed May 15 - 19, 1972*

Buoy	Latitude North Deg.	Min.	Sec.	Longitude West Deg.	Min.	Sec.	Depth of Meters (m)	Water Depth (m)
51	43	59	18	77	40	32		13
52	43	58	15	77	40	33		19
53	43	57	08	77	40	36		24
54	43	56	04	77	40	40		32
55	43	55	29	77	40	39	10	35
56	43	54	56	77	40	44		39
57	43	54	21	77	40	46		41
58	43	53	49	77	40	47		44
59	43	53	14	77	40	48	10	49
60	43	52	08	77	40	51		57
61	43	51	06	77	40	55		65

8. *Intercomparison Moorings for Current Meters near Niagara Towers - installed May 11, removed June 9, 1972.*

Buoy	Latitude North Deg.	Min.	Sec.	Longitude West Deg.	Min.	Sec.
1	43	17	05	79	08	10
2	43	17	06	79	08	18

9. *Wave Moorings - installed April 19 (11, 2) and April 12(8)*

Buoy	Latitude North Deg.	Min.	Sec.	Longitude West Deg.	Min.	Sec.
8	43	49	23	78	02	49
11	43	47	45	76	49	39
2	43	31	00	79	19	00

10. *Thermograph Moorings - installed April 10 (Deepest Sounding), March 23(7), and March 28(3)*

Mooring	Latitude North Deg.	Min.	Sec.	Longitude West Deg.	Min.	Sec.	Water Depth (m)
Deepest Sounding	43	30	39	76	57	27	245
3	43	25	00	79	17	00	118
7	43	38	48	78	29	30	143

11. *Niagara Towers*

Three towers and barge located within $\frac{1}{4}$ mile radius of the following coordinates:

43° 17 '05" N; 79° 07 '55" W.

12. *Water Temperature Gauging Shoreline Stations. The nominal depth of the sensors at all the sites is: near bottom sensor 9.2 m; near surface sensor .15 to .60 m.*

Sensor Location	Latitude North Deg.	Min.	Sec.	Longitude West Deg.	Min.	Sec.	Date of Installation
Oshawa	43	51	36	78	49	12	Bottom sensor - Nov. 15 1970 Surface sensor - June 20 1972
Kingston	44	12	48	76	35	48	Bottom sensor - June 8 1971 Surface sensor - April 25 1972
Point Petre	43	50	33	77	10	24	May 25, 1972
Cobourg	43	57	00	78	09	42	April 22, 1972
Toronto	43	38	06	73	19	08	Bottom sensor - May 10, 1972
Burlington	43	18	03	79	47	03	May 15, 1972
Port Weller	43	14	42	79	13	24	May 18, 1972

13. *Bedford Towers*

	Latitude North Deg.	Min.	Sec.	Longitude West Deg.	Min.	Sec.	Date of Installation
1	43	28	42	79	33	36	May 11
2	43	53	48	78	09	18	May 13
3	43	29	06	76	36	00	May 24

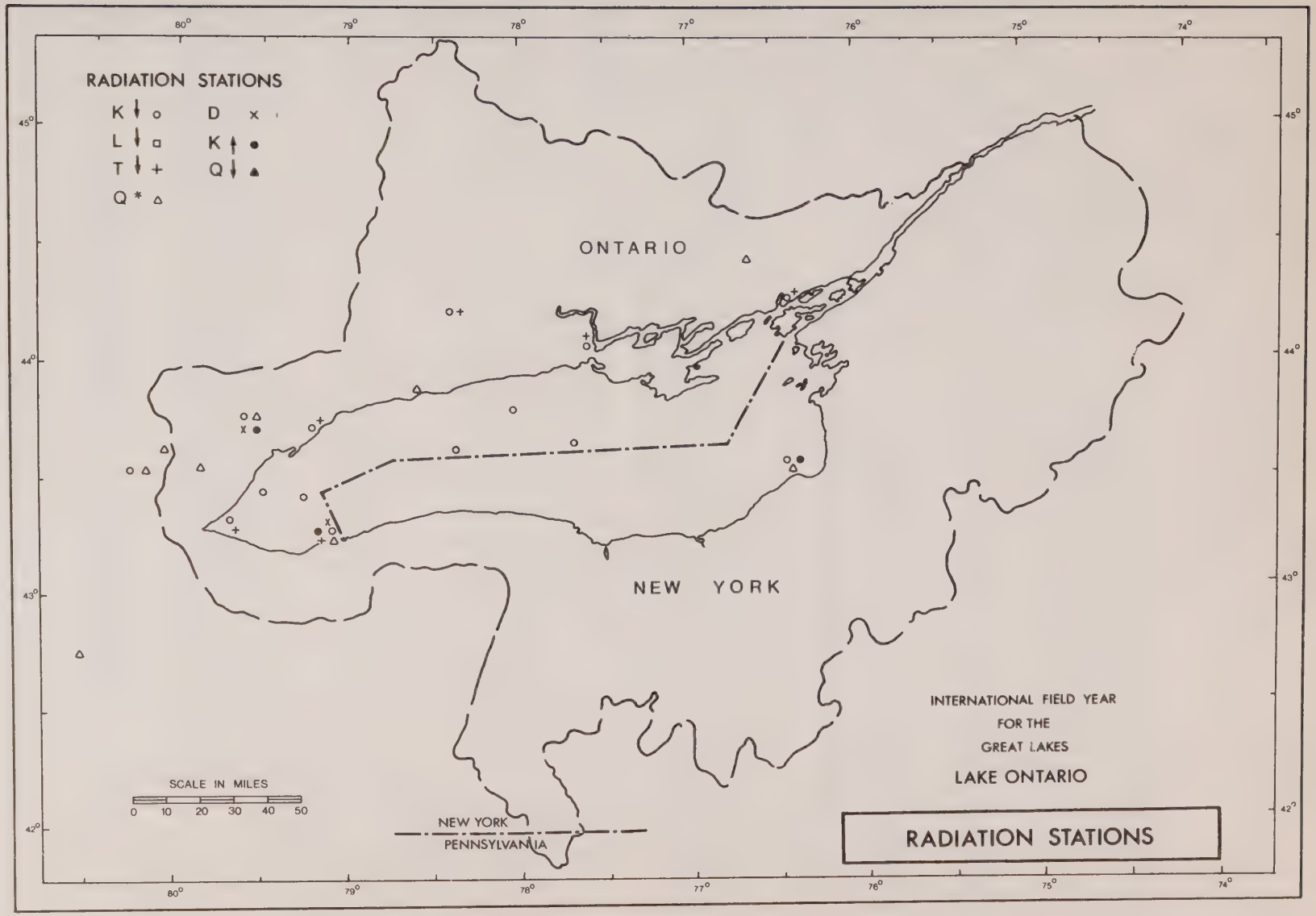

Figure 9. Positions and types of operational radiation stations.

CANADIAN DATA MANAGEMENT

Organization of Data Management

The Data Management Panel co-chairman is Dr. H. S. Weiler at the Canada Centre For Inland Waters. This position is equivalent to the U.S. IFYGL Data Manager, (Mr. D. Drury), with whom he has direct links.

Present support personnel for data management include one full-time programmer, and two clerks.

Functions of the Canadian IFYGL Data Bank

The following responsibilities belong to the area covered by Canadian data management.

(1) Provision of information for inclusion in the Data Catalog, by collecting and sending these data to the U.S. Data Management.

(2) Provision of a data link with the U.S. Data Bank, for access, retrieval, physical transport, and exchange of data.

(3) Provision of a data link with Canadian data sources and archives.

(4) Provision of an archiving facility for IFYGL data.

(5) Design and production of Data Summaries, of all relevant IFYGL data.

Work in Progress

The following broad task areas are being undertaken:

(1) Shipboard Data.

U.S. - Analog tapes are being delivered to CCIW, and are being decommutated. The resultant digital tapes are sent to the U.S. IFYGL Data Centre. Duplicate copies of all documentation is being produced, for both U.S. and Canadian Data Banks.

Canadian - Shipboard data is being entered on standard STAR files.

(2) *Meteorological Buoy, Current Meter, and Shore Station Data.*

U.S.-Arrangements are being finalized to access and receive data from the U.S. Texas Instrument network.

Canadian-Meteorological buoy and current meter data will be transferred from present edited files to standard TSAR files.
-Shore station and Bedford buoy data collected by AES will be accessed, after final technical arrangements have been completed.

(3) *Other data from individual projects.*

Initial handling and storage procedures have been set up for some of the projects. Work on others is continuing.

(4) *Canadian contribution to the Data Catalog.*

With few exceptions, Canadian contributions to the catalog are up to date.

(5) *Data Summaries.*

Initial arrangements have been made to place summaries on microfilm. Design and implementation of summarization procedures for shipboard, meteorological buoys, current meters, and shore stations, has begun.

(6) *Data links to the U.S. IFYGL Data Centre.*

Procedures to handle major data sources, ie. ships data, have been agreed to, and are operational.

THE THERMAL STRUCTURE AND HEAT CONTENT OF LAKE ONTARIO, PRELIMINARY RESULTS

F. M. Boyce

Introduction

As a part of the Energy Balance program a series of lake-wide temperatur surveys was undertaken as follows:

Survey Dates 1972	Canadian Ships	U.S. Ships
4 - 7 April	Limnos & Porte Dauphine	
10 - 13 April	Limnos & Porte Dauphine	
17 - 19 April	Limnos & Porte Dauphine	
24 - 26 April	Limnos & Porte Dauphine	
1 - 4 May	Limnos & Porte Dauphine	
8 - 10 May	Limnos & Porte Dauphine	
16 - 18 May		Researcher & Advance II
23 - 26 May		Advance II
30 - 2 June		Researcher & Advance II
5 - 9 June	Limnos & Porte Dauphine	

For each cruise the temperature structure was studied and a brief descri ptive account was composed. In addition the heat storage in various layers of the lake was computed and a digest was prepared of the weather conditions in five-day periods which immediately preceeded each cruise. Extracts from these full reports are given below.

April 4 - 7, 1972

Main Features

The winter thermocline (represented by the 2°C isotherm) lay deeper than 100 m and its mean level from section to section sloped downward to the east.

The bottom waters were exceptionally cold with a maximum temperature of 2.7°C.

The form of the winter thermocline suggested an active bottom circulation, possibly with a counter-clockwise gyre in the western basin of the lake.

There was no evidence of warming near the shores; in fact the colder water mass encountered in the main body of the lake lay on the North shore off Prince Edward County.

Computations of the depth of the maximum density gradient and the Brunt-Vaisala (B-V) period associated with that gradient show:

(a) A dish-shaped structure of that surface in the main body of the lake.
(b) A B-V period of between 13 and 14 minutes associated with that surface.

The minimum B-V period for all stations ranged from 12 to 15 minutes. Only in one of the five sections does the depth of maximum density gradient appear directly associated with the main thermocline.

Fine Structure

The winter epilimnion in the main body of the lake was characterized by thick isothermal layers of vertical dimensions of the order 30 m separated by small temperature discontinuities of about 0.05°C change.

The winter thermocline showed considerable evidence of microstructure. Much of the structure was in the form of alternating layers and sheets (temp. discontinuities) with layer thicknesses of the order 2-4 m.

The temperature profiles in the northeast portion of the lake (Kingston Basin) were devoid of microstructure and were uniform from surface to bottom.

Main Features

The soundings showed evidence of a winter thermocline below 100 m depth. The transverse slope of the 2°C isotherm varied from section to section as follows:

Section (limiting Station Numbers)	Direction of slope of 2°C Isotherm (downwards)	Estimated Mean Depth of 2°C Isotherm
8 - 12	South	105 m
20 - 26	North	115 m
32 - 37	South (small)	110 m
45 - 51	South	135 m
59 - 64	North (small)	130 m

The longitudinal slope of the mean transverse depth of the 2°C isotherm was downwards to the east.

It is doubtful whether this topography represented any permanent flow; it seems more likely to be the result of a standing internal wave system of low nodality.

The coldest water was encountered off the Niagara River (0.7°C) in a relatively small zone. A cold water mass (mean temperature approximately 1.3°C) occupied the epilimnion in the Western basin and its Eastward boundary ran from Thirty Mile Point (South shore) to Long Point (North shore) on a line roughly parallel to the sill separating the Eastern and Western Basins.

The maximum observed bottom temperature was 2.9°C.

There was evidence of warming near the shore and movement of warmed water down the bottom slope to the deeper portions of the lake.

The B-V period for the main thermocline had an average value of 14.5 $\pm$ 0.3 minutes.

Changes from previous cruises:

(a) Warmer bottom temperatures (increase of 0.2°C)
(b) Evidence of warming near shore and in Kingston Basin.
(c) More complex thermocline topography

Fine Structure

Epilimnion:

Two features were commonly observed. The first was a number of small temperature discontinuities (0.05°C) spaced at vertical intervals of about 10 m. These features were more common in the deeper portions of the lake and particularly in the Southeast (deepest zone). The group of stations on the north shore off Oshawa were characterized by extremely uniform temperatures in the upper layer. The second feature was the existence of small unstable temperature gradients near the surface. These occurred in the early afternoon on calm days and may be taken to indicate heating from the surface.

Thermocline:

The thermocline zone - in all stations where it clearly existed - showed much fine structure in the form of step-like alterations of strong and weak thermal gradient. The vertical scales of these features ranged from 2 to 3 m; the temperature changes were of the order 0.1°C.

Hypolimnion:

Occasionally, a very thin zone of warm water was found near the bottom. The zone had no apparent connection with the winter hypolimnion. The regions where this zone was observed were near the shore where the bottom slopes lakeward. This may be evidence of water warmed at the shoreline sinking and flowing along the sloping bottom. This feature was not observed on the earlier cruise.

April 17 - 19, 1972

Main Features

Compared with previous cruises, each section showed a significant warming of the upper layer (winter epilimnion). A core of cool water (1.4°C) extended from off Ajax into the eastern basin occupying a vertical zone of about 100 m and lying close to the north shore. Near the shore, the water had temperatures in excess of 2°C and there was evidence of cold water moving along the bottom to the deep portions of the lake. The winter hypolimnion had diminished in volume, and the mean temperature of the hypolimnion had dimin-

ished - evidence of entrainment of cool water from the epilimnion. The thermocline sloped down from north to south over the central deep portions of the lake. The B-V period for the main winter thermocline was 14.4 $\pm$ 0.4 minutes - not significantly different from the previous cruise. The B-V period associated with microstructure ranged form 12.3 to 15.1 minutes.

Changes from previous cruise:

(a) Warmer epilimnion temperatures (+0.2°C)
(b) Cooler hypolimnion temperatures
(c) Reduced hypolimnion volume

Fine Structure

The upper layers were very isothermal - more so than on previous cruises.

Day time stations showed unstable fine structure at the surface - evidence of heating.

Nearshore stations all showed warmer water on the bottom.

Fine structure in the main winter thermocline was much diminished; the smoother thermocline regions are perhaps indicative of an active entrainment process.

April 24 - 26, 1972

Main Features

The central portions of the lake still showed stable winter stratification. A pool of cold water (minimum temperature of 1.5°C) extended north of, but parallel to the major axis of the lake centred around station 35. The winter thermocline existed only to a limited extent in water deeper than 130 m. The shore zones showed an accumulation of warmer water (temperatures as high as 3.6°C). The location of this water in relation to the lake wide cross section indicated motion of some kind.

Temperature data from rivers flowing into Lake Ontario on the Canadian shore showed temperatures of 6°C and higher.

The minimum B-V periods ranged from 13 to 15 minutes with the period associated with the thermocline being about 14.7 minutes. On most profiles, the minimum period was associated with fine structure or the subsurface offshore flow of warm water.

Fine Structure

The fine structure nearshore had vertical scales of about 4 m whereas that of the winter thermocline project had smaller vertical scales - approaching 1 m. This was probably the result of active mixing as the warmed inshore water moved offshore along the bottom. Daytime surface heating and nightime cooling were visible in some profiles; temperature anomalies associated with these processes were of the order 0.2°C.

May 1 - 4, 1972

Main Features

The winter thermocline persisted only in the deepest portions of the lake below 140 metres. Pronounced summer stratification existed at some inshore stations on the southern shore (12, 51, 52, 64, 65) where the bottom slope was relatively gentle. Stations 3, 14 (Niagara River influence), 26, 27, 37, 38 showed isothermal profiles except near the bottom where evidence of lakeward flow of warmed water persisted. The shore stations on the northern shore were similar to stations 2, 26, 27, 37, and 38.

The 4° isotherm was encountered in some of the transects but the most striking feature was the near vertical orientation of the isotherms away from the solid boundaries of the lake. Another feature was the lack of homogeneity of the inshore temperature structure as one moved around the periphery of the lake. It would appear that this structure was determined by local factors such as river flows (station 51 near Rochester) and bottom topography.

The water in the Kingston basin was homogeneous from surface to bottom at temperatures near 3.0°C.

Fine Structure

Away from the zones where a stable warm epilimnion was forming, the temperature profiles in the surface water were very nearly isothermal. Close inspection revealed some layering with temperature discontinuities of 0.05°C and layer thicknesses of the order of 10 m. This type of structure was less well-marked than on earlier cruises. The warmed bottom water originating at the shores produced ragged temperature profiles indicative perhaps of turbulent mixing.

The minimum B-V periods associated with winter thermal structure ($T < 4°C$) were grouped around 15 minutes. The minimum periods associated with a warm upper layer ($T > 4°C$) were much less, 5.6 minutes at station 12, 2.8 minutes at station 78, and 9.6 minutes at station 65.

Main Features

The large scale thermal structure of the lake was similar to that of the previous cruise. However the core of the lake was more homogeneous than before and its temperature had risen by approximately 0.2°C, indicating active vertical mixing down to 150 m depth at least. A faint residual of the winter themocline persisted at Station 36. Nearshore, the isotherms were more nearly vertical. Some of the temperatures recorded on the south shore (Station 51, 64) had diminished whereas those on the north shore had all increased. The 4°C isotherm was not yet encountered all around the shore of the lake. There was less evidence of the lakeward movement of warmed water along the bottom as the driving density differences became less.

The minimum B-V periods fell into two groups, one centered on 15 minutes representing the "isothermal" conditions (note the increase in this period from previous cruises - indicative of less thermal structure offshore), and the other of periods ranging from 5 to 10 minutes at stations located near the shore where the water column had taken on summer stratification.

Fine Structure

In the main body of the lake away from the warmed shore regions, isothermal conditions were encountered from the surface to very near the bottom. The warmed water near the bottom rarely exceeded by 0.3°C the temperature of the isothermal water above it. Microstructure was principally encountered in this warmed bottom water. Some of the "isothermal" columns showed evidence of a thermal "noise" less than the meaningful resolution of the X-Y plots (0.05°C). The step-like structures ($\Delta T \sim 0.05°C$, $\Delta Z \sim 10m$) found on the April 4 - 7 cruise were absent.

The nearshore zones, where summer stratification had occurred, showed much variability in the thermocline region. A particularly violent example was obtained at Station 79 located, one presumes, very near the thermal bar. Surprisingly, this profile represented, in its main features, a stable density distribution.

The stations taken in the east end of the lake (Nos. 81, 87, 85, 89, 84) showed the sediment temperature as being about 0.3°C lower than the temperature of the water immediately above. This was not observed elsewhere in the lake.

May 16 - 18, 1972

Main Features

Two salient points appear on comparing the data from this cruise with the data obtained 8 days earlier. First, the isothermal surfaces of temperatures greater than 4°C, which were located in the nearshore regions,had become more nearly horizontal. Second, lakewards of the 4°C isotherm, the water was homogeneous in the vertical and temperatures had increased about 0.2°C from top to bottom with respect to the previous cruise.

Warm water and stable summer stratification were established around the shoreline.

May 23 - 26, 1972

The changes noted on 16 - 18 May in the large scale features continued to occur. Summer stratification was firmly established inshore. The central core of the lake was homogeneous in the vertical to within 0.5°C. The surface temperature distribution (1m depth) was considered a "classic" thermal bar situation.

May 30 - June 2, 1972

The set of data was not entirely complete. The portion of the lake west of the line Toronto-Niagara was completely stratified. Elsewhere, the sections resemble those of the 23 - 26 May cruise with the exception of the section running from Long Point to Oswego (Station 71 to 78) where the warmest water had moved offshore on the north side. The two sections to the west showed a very thin epilimnion on the north side.

June 5 - 7, 1972

Main Features

The large scale thermal structure was very similar to that of the May 30 - June 2 cruise: the western end of the lake was fully stratified, the deep core of the lake remained homogeneous but continued to warm steadily. On the northeast shore of the lake the warmest water was found offshore, an extension of a feature first noted in the May 30 - June 2 cruise.

Fine Structure

Generally, the temperature profiles showing summer thermal stratification were characterized by relatively strong temperature gradients extending to the surface - as opposed, for example, to the late summer core where essentially isothermal mixed upper layers existed. This feature was attributed to strong solar heating. The temperature gradients in the thermocline were smaller (absolute value) than those found later in the summer. The strength of these gradients may be measured in terms of the minimum B-V period. In the stratified zones this period ranged from 2 to 5 minutes, average around 3. Summer values in Lake Ontario were often less than 2 minutes. Below the depth of maximum temperature gradients, the structure often exhibited small scale features best described as "wavy" in a rather unorganized way (as opposed, for example, to the sheets and layers sometimes observed in the autumn).

The cold core of the lake exhibited very little fine structure and departed from isothermal only to the extent of a certain "noisiness" near the surface indicative perhaps of strong heating. A vague remnant of the winter thermocline was seen at Station 62.

Heat Content

The heat content of the lake as a function of time is shown on Figure 10.

The changes in absolute heat content are quite uneven and probably can be explained by short-term meteorological influences. The overall gain in heat (slope of the mean curve in Figure 10.) is consistent with previous data (Dolling 1971) but shows a lag of about 10 days with respect to the 1970 curve.

The computations continue to be made with respect to chart datum - assuming in effect that the level of the lake lies at datum. Since the levels are a metre or more above datum, an error is made. This small error will be eliminated in the final computations. For present purposes the unrefined calculations are adequate to delineate changes in heat content from cruise to cruise.

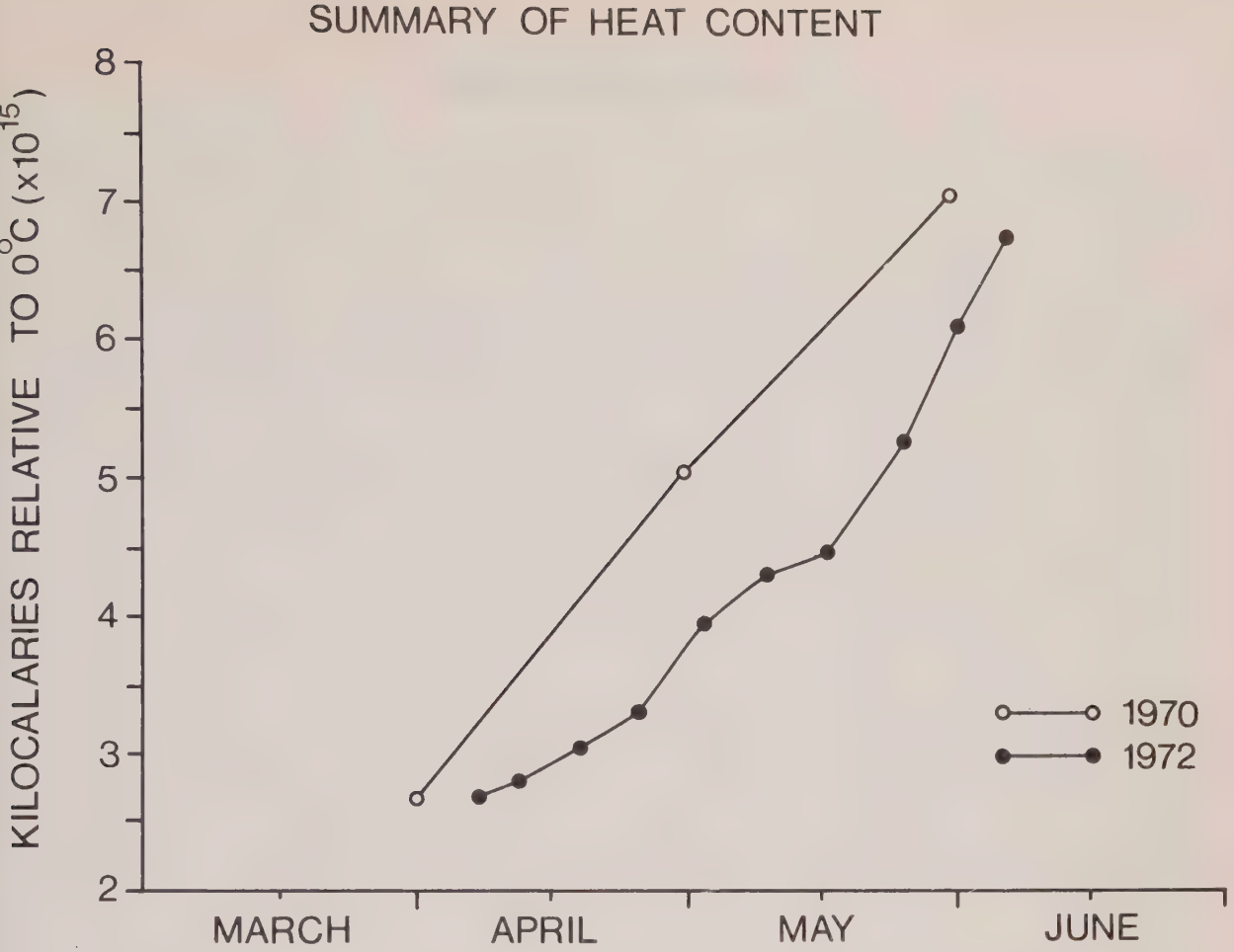

Figure 10. Heat content of the lake as a function of time (10^{15} kilocalories = 4.185 x 10^{18} Joules).

THE LEVEL OF LAKE ONTARIO

Six Canadian gauges are installed in the basin and their hourly readings are tabulated and available within a few days of the ending of each month.

The level of Lake Ontario rose rapidly during April and early May to a level which has not been exceeded since 1956. This level was maintained through to the end of August when the lake was higher than it has been for 20 years, and was at a level only exceeded eleven times in the past 100 years.

Table 3. The monthly mean elevation in 1972 of the surface of Lake Ontario above the Mean Sea Level in the St. Lawrence at Father Point, P.Q. (feet).

	April	May	June	July	August
Port Weller	245.40	246.25	246.42	246.67	246.37
Toronto	245.49	246.37	246.52	246.78	246.48
Cobourg	245.48	246.34	246.49	246.75	246.47
Kingston	245.33	246.16	246.33	246.67	246.36
Burlington	245.73[1]	246.40	246.54	246.80	
Pt. Petre	246.28	247.03	247.23	247.57	

[1]No record for April 4 - 14, 1972

COORDINATOR'S NOTES

A Field Year for the Baltic Sea in 1974

IFYGL Investigators may be interested to know that the Baltic countries are cooperating in a study of the water balance of the Baltic Sea. This important work only recently became a reality although such a proposal has been under consideration for over 50 years. The study is within the framework of the IHD and is under the patronage of the International Council for the Exploration of the Sea through the Conference of Baltic Oceanographers. The work todate has been to take two ten year periods, 1951 - 1960 and 1961 - 1970. In addition a fewer number of long established recording stations will be studied for the 30 year period 1931 - 1960. Calculations of stream flow to the Baltic for the 1951 - 1960 period are now published; calculations for the 1961 - 1970 period are at an advanced stage. The IHD are facilitating the exchange of data necessary for the long period inflow variability studies using the 30 years of record. A number of problems exist, for example, the usual evaporation and precipitation uncertainties and the large exchange of water between the Baltic and North Seas. Comparative studies are planned of the amount of precipitation and evaporation over the sea and sea coast areas. In 1969 Denmark started regular research on the process of exchange between the North and Baltic Seas based on the simultaneous measurements of currents, sea levels, wind fields, water temperatures, and chemical parameters. The year 1974 has been designated as a year of intensive simultaneous observation of all elements in the balance.

The overall aim of this study is to establish in 1976 an ongoing basin management technique based on a reduced number of stations which provide an input to a mathematical model of the basin. At that time the Baltic countries will have at their disposal the full balance for the twenty-five year period 1951 - 1975, together with a realistic model for computing the balance from 1976 onwards.

The information is this report was culled from details sent to the Coordinator of the IFYGL by Prof. Dr. Zdzislaw Mikulski, Institute of Geography, Warsaw University, Poland.

In view of the increased use, pollution threatens disadvantageous changes in the quality of the Baltic Sea. The organizers of the Baltic Field Year hope that their initiatives taken to deal with the water quantity aspects will soon be extended to cover water quality aspects of the basin.

Earth Resources Technology Satellite

ERTS was successfully launched into a circular orbit on 23 July 1972 and is sending its imagery data direct to Canada from its vantage point at 910 km altitude. There are three or four daylight orbits per day over some part of Canada. The swath covered on the ground is 185 km wide and overlaps the previous and following day's coverage. This overlapping pattern repeats itself every 18 days.

Imagery is provided by two sensor systems, a three-camera Return Beam Vidicon (RBV) system and four-channel Multispectral Scanner (MSS). The RBV system recognizes 2:1 contrast ground objects of about 100 m in size. The three RBV cameras are filtered to record information in different parts of the visible and near infrared waveband. The green filtered camera (475 - 575 nm) gives maximum penetration into water. The red filtered camera is particularly useful for the study of cultural (man's impact) features and has a greater power of haze penetration than the green channel. The infrared camera (690 - 830 nm) defines the margin of water bodies and determines the distribution and vigour of plant life. Two types of false colour prints are produced from the MSS data for a variety of applications.

The Canadian read-out station at Prince Albert, Saskatchewan, is operational and orders for the data can now be placed with the National Air Photo Library, Attn. Remote Sensing, 615 Booth Street, Ottawa, Ontario K1A OE4 using the Canadian ERTS - 1 Standing Order Form available from the same address. An explanation of information needed is given in Table 4. Photographs will be dispatched within two weeks of acquiring imagery meeting the standard specified. The prices anticipated for each $1:10^6$ scale, 250 mm side copy are:

Black and white print	$1.00
Black and white transparency	2.00
Colour print	3.00
Colour transparency	5.00

Table 4. Details of order information necessary for ERTS-I photographs

Geographic points

Latitude and longitude for 1 - 6 points defining point, line, or area for which coverage is desired. The corner points of an area should be arranged cyclically and the border must be convex.

Cloud cover

Maximum acceptable cloud cover in %.

Table 4. (Continued)

Minimum Quality

The poorest quality imagery acceptable, specified by:

Good - complete images with good tone, resolution, and granularity. Little or no noise.
Fair - lighter or darker than good imagery, or noticeable noise.
Poor - imagery which is too light or too dark, partial images or significant noise.

A user who specifies Fair, for example, would receive all fair and good imagery.

Coverage Period

The beginning and end dates of the time period for which imagery is desired.

RBV and MSS Bands

The sensor and spectral band from which black and white imagery is desired.

RBV	Band 1	475 - 575 nm (blue green)
	Band 2	580 - 680 nm (red)
	Band 3	690 - 830 nm (near infrared)
MSS	Band 1	500 - 600 nm (blue green)
	Band 2	600 - 700 nm (red)
	Band 3	700 - 800 nm (near infrared)
	Band 4	800 -1100 nm (near infrared)

MSS Colour

The MSS false colour composite prints desired:

(1) Bands 1, 2, 3.
(2) Bands 2, 3, 4.

Data Catalogue Sheets

Extra copies of IFYGL data catalogue sheets are now available for some projects from Data Processing, CCIW. If you would like to see these sheets for any project please order by project number from:

Mr. J. Byron,
Computer Services Section,
Canada Centre for Inland Waters,
Burlington, Ontario.

If no extra copies are immediately available your order will be held and the Data Catalogue Sheets forwarded to you as soon as possible. There will be no charge for this service.

Canadian Fishery Projects

This program is being undertaken by the Ontario Ministry of Natural Resources in cooperation with the Royal Ontario and the National Museums. The various activities are supported by three vessels as indicated in Table 5.

The sailing schedules, and operating ports, for the Cottus and Keenosay are given in Tables 6 and 7. The vessel Namaycush works a 5-day week, operating from Glenora, Ontario, to an observing schedule which repeats itself every sixth week as shown in Table 8. Each vessel returns to port every night and sends the first sample to Glenora for processsing.

Ships' Activity

A total of thirty-eight cruise reports were filed with the IFYGL Centre since the last issue of the Bulletin, bringing the total to fifty-three IFYGL cruises. Some of the cruises were investigative, others were undertaken in order to install and maintain the buoy-supported observing systems.

The Heat Content and Cross Lake Transect Cruises were integral parts of the Energy Balance program. The Surface Eutrophication and Organic Particle Study cruises were in support of the Biology Chemistry program. The Diffusion Study supported the Water Movement program. In addition, a start was made with the bathymetric work, which supports all facets of the program.

Three major observing systems were installed and serviced: viz., the eleven meteorological buoys, the sixteen current meter moorings, and the four fixed temperature profilers. These systems were illustrated in Figures 1, 2 and 3 in IFYGL Bulletin 3, Canadian Section. Each system had its own tape recorder which was recovered and replaced during these cruises. In addition, two cruises were concerned with the operation of the IFYGL Decca position fixing system.

Table 5. Canadian fishery projects

	Trawling	Gillnetting	Trap-netting	Shore Seining	Plankton Sampling	Tagging	Limn-ology	Larval Fish Trawling
Vessels								
Cottus	x	x						x
Keenosay	x	x						x
Namaycush	x	x			x		x	
Shore Bases								
Pt. Credit		x		x	x			
Oakville		x		x	x			
Grimsby		x		x	x			
Shelter Valley Ck.		x	x	x	x			
Indian Pt.		x	x	x	x	x		
Bay of Quinte (6 zones)			x	x		x		
ROM, Toronto				x				
National Museum Ottawa				x				

Table 6. RV Cottus sailing schedule

IFYGL Cruise	Date	Location
VI	July 20 - 23	Pt. Credit
	July 24 - 26	Cobourg
	July 27 - 30	Pt. Traverse
	July 31 - Aug. 3	Eastern Outlet Basin (sails from Pt. Traverse)
VII	Aug. 8 - 24	Vertical distribution studies (all based at Pt. Traverse)
VIII	Aug. 29 - Sept. 1	Eastern Outlet Basin
	Sept. 2 - 5	Pt. Traverse
	Sept. 6 - 9	Cobourg
	Sept. 10 - 13	Pt. Credit
IX	Sept. 19 - Oct. 5	Vertical distribution studies (all based at Pt. Traverse)
X	Oct. 10 - 14	Pt. Credit
	Oct. 15 - 18	Cobourg
	Oct. 19 - 22	Pt. Traverse
	Oct. 23 - 26	Eastern Outlet Basin

Table 7. RV Keenosay sailing schedule

Date	Location
Aug. 8 - 11	Through Welland Canal, tie up Oakville
Aug. 14 - 23	Oakville - Whitby - Cobourg;trawl cruise
Aug. 28 - 31	Oakville - Pt. Credit; gillnet and larval fish trawling
Sept. 5 - 14	Oakville - Whitby - Cobourg; trawl cruise
Sept. 19 - 28	Oakville - Whitby - Cobourg; trawl cruise
Oct. 3 - 6	Through Welland Canal

Heat Content and Surface Eutrophication Study

The purposes of this series of cruises were to compute the heat content f Lake Ontario, describe the seasonal and spatial changes of lake temperature, nd to study the particle and chlorophyll distribution in the surface waters s a function of time and space. Two vessels were used simultaneously, CSS imnos and CCGS Porte Dauphine, to cover the networks shown in Figures 2 and 3 f IFYGL Bulletin 2. The dates of the first seven surveys were 4 - 8 April, 0 - 13 April, 17 - 20 April, 24 - 26 April, 1 - 4 May, 8 - 11 May, and - 7 June 1972. The operations and scientific staff concerned were D. J. rooks, F. M. Boyce and Dr. G. K. Rodgers. A preliminary analysis of results s given earlier in this Bulletin.

Cross Lake Temperature Transects

These cruises were undertaken in order to detect long internal wave otions in Lake Ontario. During the course of the cruise, CSS Limnos sailed ack and forth across the lake from Oshawa, Ontario, to Olcott, New York, tow- ng the undulating batfish device and the towed temperature profiler (see igure 7, Canadian Section, IFYGL Bulletin 3). On 10 - 14 July, twenty-three ransects were completed and on 8 - 12 August 1972, the number of crossings as twenty-one. The operational and scientific staff leaders were D. J. rooks and F. M. Boyce.

Ontario Organic Particle Study (OOPS)

The reports of four out of the nine planned cruises were filed by the nd of August 1972. Each cruise extended over a two-week period with Phase I n the first week and Phase II in the second week. The Phase I objectives ere to determine the spatial distribution of phytoplankton, to determine he spatial difference in selected chemical parameters at various depths, and o measure organic particle production and settling rates. The Phase II bjectives were to investigate daily variations of phytoplankton and zooplank- on along with selected chemical parameters, to measure in situ integral rimary production, to investigate vertical migration of zooplankton, and to tudy photosynthesis and light variations. The cruise tracks and station ocations for both phases are shown in Figures 4 and 5 of this Bulletin. The V Martin Karlsen was used for this work on 10 - 22 April, 23 May - 3 June, 9 June - 1 July, and 17 - 29 July 1972. The operations and scientific staff eaders were D. H. Hannington, Dr. W. Glooschenko, Dr. N. Burns, Dr. P. tadlemann and J. Moore.

Diffusion Study

The objectives of this experiment were to study diffusion in the pilimnion of the open lake using Lagrangian techniques. Parcels of water ere tagged with tracers and followed with time as lake currents and eddies ispersed the marked water parcels. Two types of distinctly different tracers

were used. The first type of tracer consisted of a group of ten drogues released at the mid-point of the epilimnion and then followed with time. The second tracer consisted of a 0.1 M^3 blob of rhodamine dyed liquid with unity density and released at the same depth as the drogues. The concentration profiles in horizontal and vertical directions were observed by means of fluorometric survey from the ship and launches. In addition, time sequence aerial photography was employed. The study was conducted south of Oshawa. Following a trial on 29 - 31 May, operational cruises were undertaken using CSS Limnos, and the launches Aqua and Lemoyne, on 26 - 30 June, 17 - 20 July, and 14 - 19 August 1972. The operations and scientific staff involved were D. J. Brooks and Dr. R. Murthy.

Bathymetric Survey

The first of the three planned cruises was completed by CSS Limnos on 12 - 22 June. About 1500 n mi. of bathymetry and some 30 n mi. of seismic data was acquired under the direction of F. L. De Grasse.

Buoy Maintenance and Service

Nineteen cruises of CCIW vessels have been concerned with the installation and service of the lake-wide network of meteorological sensors, current meters, thermistor chains, coastal chain stations, and Decca chain marker buoys. The schedule of the activities completed to date is given in Table 9.

Aircraft

Lake Surface Temperature by ART

The Atmospheric Environment Service's Air Radiation Thermometer (ART) was used for surface water temperature surveys on twenty occasions since the commencement of the IFYGL. Isotherms at $1^{o}C$ intervals were drawn up on 1:1.3 x 10^6 scale maps , and these maps were distributed to an extensive mailing list. The surveys took place on the following dates, where parentheses indicate that conditions restricted the flight to the western half of the lake: 27 March; (7), (11), 12, 17 and 25 April; 1, 9, 23 and 29 May; 5, 7, 12 and 27 June; 4, 24, and 31 July;8, 18 and 30 August 1972.

Canada Centre for Remote Sensing Activity

A summary of the missions undertaken by CCRS in support of IFYGL programs is given in Table 10. Brief details of the programs are given earlier in this Bulletin.

Table 8. RV Namaycush cruise schedule (1972)

Day	July 10 - 14 Aug. 14 - 18 Sept. 18-22	July 17-21 Aug. 21-25 Sept. 25 - 29	July 24-28 Aug. 28 - Sept. 1 Oct. 2 - 6	July 31-Aug. 4 Sept. 4 - 8 Oct. 9 - 13	Aug. 7 - 11 Sept. 11 - 15 Oct. 16 - 20
Monday	Primary productivity and chemistry - Upper Bay				
Tuesday	Primary productivity and chemistry - Lower Bay				
Wednesday	Gillnetting	Gillnetting	Trawling	Limnology Survey and Zooplankton Sampling	Limnology Survey and Zooplankton Sampling
Thursday	Lower Bay	Upper Bay	throughout		
Friday	Stations	Stations	Bay		

Towers

Micrometeorological Site

The towers set up near Niagara-on-the-Lake were operational during the alert periods of the Atmospheric Boundary Layer program. Data for the pre-IFYGL period 26 September to 14 October 1971 were released by Dr. S.D. Smith A.O.L. and can be obtained from the Data Bank.

Bedford Buoys

These taut-moored spar buoys were operational off Oakville and Cobourg, Ontario.

The Atmospheric Environment Service found that it was not possible to correctly moor the tower off Oswego, New York.

Project List

The following are changes and additions to the project list given in Appendix I, Bulletin 2. As before, new projects are described only briefly. More information on these projects together with progress reports provided by the project leaders on the other projects can be found in Canadian Projects Supplement 1, available from the Canadian Coordinator.

12	TW	Withdrawn
19	ME	Included in 66ME
41	BL	Withdrawn
71	EB	Project leader changed from R. J. Latimer, AES, to J. A. Davies, McMaster University.
77	BL	Withdrawn
82	BC	Withdrawn
84	BC	Project leader changed from J. Neil, OWRC, to G. E. Owen, Ontario Ministry of the Environment (formerly OWRC)
93		Withdrawn
99	BC	Withdrawn
100	BC	Withdrawn
112	BC	A study of the structure and ecologic relations in the Threespine Stickleback in Lake Ontario (E. T. Garside, Dalhousie University
113	BL	To determine the atmospheric heat and water budget of the lake and basin, using sensors and aircraft platforms (R. M. Holmes, ERA Instruments).

Table 9. Canadian Buoy and System Service

System	Dates, 1972	Ship[1]	Task
Decca	13-16 March	MK	Install 12 spar buoys
Decca	3-9 April	MK	Decca calibration
Meteorological	21-30 March	MK	Moored buoys 1, 7, 8, 9, 10 and 11
Meteorological	27-28 March	L	Moored buoys 2, 3, 4, 4A, 6 and 13
Meteorological	5-11 April	LE	Instrumented buoys 1, 2, 3, 4, 5 and 6
Meteorological	18-25 April	LE	Instrumented buoys 7, 8, 9, 10 and 11
Meteorological	30 April-4 May	LE	Service Met. and FTP buoys
Meteorological	15 - 19 May	LE	Service Met. and FTP buoys
Meteorological	29 May-2 June	LE	Service Met. and FTP buoys
Meteorological	12-16 June	LE	Service Met. and FTP buoys
Meteorological	27 June-1 July	LE	Service Met. and FTP buoys
Meteorological	10 - 14 July	LE	Service Met. and FTP buoys
Meteorological	24 - 28 July	LE	Service Met. and FTP buoys
Meteorological	1 - 5 August	LE	Service Met. and FTP buoys
Meteorological	8 - 12 August	LE	Service Met. and FTP buoys
Meteorological	21 - 24 August	LE	Service Met. and FTP buoys
Current Meters	15 - 19 May	L	Establish 16 moorings, 3 FTP
Current Meters	4 - 8 July	L	Service meters and FTP
Current Meters	21 - 24 August	L	Service meters and FTP

[1]MK - Martin Karlsen L - Limnos LE - Lac Erie

Table 10. CCRS Remote Sensing activity associated with IFYGL

Investigators	CCRS No.	Aircraft	Objective	Dates of Flight	Height (m)	Sensor	Film	Filter	Focal Length (mm)	Film Size (mm)
R.O. Ramseier	71 94	C47	To obtain information on ice in Lake Ontario and St. Lawrence river between Kingston and 1000 Islands Bridge.	5/1/72	1066	C	5063	W12	76	70
						C	2443	W12	76	70
						PRT 5				
				8/1/72	1066	C	2424	89B	76	70
						C	2443	12	44	70
						PRT 5				
						D				
				16/2/72	610	C	2405	W12	76	70
					1066	C	2443	W12	76	70
						C	2405	W12	76	70
						C	2443	W12	76	70
				18/2/72	915					
					1066					
				21/4/72	1066	C	5063	W12	76	70
							2448	Nil	76	70

Table 10. (Continued)

Investigators	CCRS No.	Aircraft	Objective	Dates of Flights	Height (m)	Sensor	Film	Filter	Focal Length (mm)	Film Size (mm)
J. N. de Villiers and G. Owen	72 12	C47	To study cladophora in association with OME using SPAR multispectral camera and 70 mm camera photographic back up. To establish best heights and then fly the shoreline of Lake Ontario.	5/6/1972	305	C	2405	12 and 58	76	70
					610	C	2445	HF 3	76	70
					1220					
					1830					
					2440 and 3048					
				19/6/72	305	C	2445	HF 3	76	70
					1220	C	2405	W 12	76	70
				5/7/72	1830	C	2405	12 and 44	76	70
						C	2445	HF 3	76	70
				15/8/72	1220	C	2445	HF 3	76	70
					1830	C	2443	W 12	76	70

Table 10.(Continued)

Investigators	CCRS No.	Aircraft	Objective	Dates of Flight	Height (m)	Sensor	Film	Filter	Focal Length (mm)	Film Size (mm)
K. P. B. Thomson and W. McColl	72 14	Falcon	Synoptic observations of Lake Ontario in support of IFYGL Projects. To cover 1040 mi. giving full cover of Lake Ontario in the periods 5 - 12 May, 5 - 9 June, 8 - 26 August, and 25 Sept. - 27 October, 1972	7/6/72	10660	C C C RS14	2445 2443 2498	nil W 12 nil	89 76 76	228 70 70

Table 10. (Continued)

Investigators	CCRS No.	Aircraft	Objective	Dates of Flight	Height (m)	Sensor	Film	Filter	Focal Length (mm)	Film Size (mm)
K.P.B. Thomson and W. McColl	72 15	C47	Investigation of the time scale of dominant thermal features and their relation to large scale circulations in Lake Ontario. To survey an area near Oshawa with several flights per day in the periods 8 - 20 May, 8 - 18 Aug., and 25 September - 7 October, 1972	10/5/72	1830	C	2445	nil	76	70
						C	2402	nil	76	70
						D				
				18/5/72	1830	C	2445	nil	76	70
							2405	nil	76	70
						PRT 5				
						D				
				19/5/72	1830	C	2405	nil	76	70
							2424	nil	76	70
						D				
				19/5/72	915	C	2405	nil	76	70
					1830	C	2415	nil	76	70
						D				
				28/5/72	915 and 1830	C	2445	nil	76	70
						PRT 5	1830	nil	76	70
						D				

Table 10. (Continued)

Investigators	CCRS No.	Aircraft	Objective	Dates of Flight	Height (m)	Sensor	Film	Filter	Focal Length (mm)	Film Size (mm)
M. M. Fitz-patrick and R. Worsfold	72 42	C47	An investigation of ground water movement and sites for engineering material. Plan to fly 183 n mi. at 9000 ft. in Prince Edward county in the June to August period 1972.							
J. R. Noble and G. Irbe	72 32	Falcon	To use the imagery taken on task 72 14.			(See 72 14)				

Erratum

Bulletin 3, page 33, final sentence in first paragraph should read:

> The changes in the fish fauna have been variously attributed to the effects of overfishing, the sea lamprey, cultural eutrophication, and colonization by new species like the American smelt.

Identification Cards

To facilitate border crossing during IFYGL a wallet size official identification card is available from the office of either the Canadian or United States Coordinator.

University Participation

Projects are being undertaken by British Columbia, Dalhousie, Guelph, McMaster, Queen's, Toronto, Trent, Waterloo, and Windsor Universities. In Bulletin No. 5 a special effort is planned to report the status of this important segment of our program.

UNITED STATES

COMMENTS BY THE U.S. DIRECTOR

In IFYGL Bulletin No. 3 we presented the status of the U.S. part of the IFYGL program through March 31, 1972. This issue covers mainly activities up to June 30, 1972, the first quarter of the Field Year (see fig. 1), but a few more recent events of July and August are also included. The progress reports on the U.S. scientific program are based on contributions by the principal investigators of the 69 individual tasks listed in Bulletin No. 3 and of one task that has been added since April 1. Other individual contributions constitute the source for the discussion of particular aspects of the field operations, data collection systems, and data management.

Since April 1, 1972, the major accomplishment has been the deployment and operation of the IFYGL data collection systems. Maintaining the operational schedule has presented some problems for several reasons, including a late ice breakup on the St. Lawrence and the necessary shakedown of the systems.

The large vessels began their cruises in May. Automatic towers and land stations were deployed and were operational in May, the buoys in June. Maintenance of the buoy systems from small boats was hampered by high waves during July and August, and there has been some lightning damage and interference with system operations. The boundary layer alert periods involving aircraft and tower data collection systems have been essentially on schedule. The radar precipitation systems have been operational most of the time, and have yielded a reasonably high percentage of acceptable data. The upper air LOCATE system is almost ready for use in data collection beginning in September.

Highlights of progress in various areas, some of which are discussed in further detail in the sections that follow, are:

- The four-volume IFYGL Technical Plan has been printed and distributed.
- The U.S. Field Headquarters in Rochester, N.Y., is fully operational. Captain Dewey Rushford of the NOAA Corps has replaced Captain Ken MacDonald as the Director of the Field Headquarters. The Field Data Center and the instrument calibration facility are fully operational.
- Data collection and data management efforts are progressing.

Intercomparisons of physical and chemical observations were conducted from the large international vessels off CCIW in June, from the U.S. vessels off Rochester in August, and intercomparisons of observations from the international vessels are planned for September. An intercomparison of buoys is underway at Station 13. The *Johnson* has been instrumented for observation intercomparison with the U.S. buoys and towers. Standard chemical samples have been collected and will be distributed for purposes of comparing procedures used by the major United States and Canadian participating chemical laboratories.

Intensive software development is underway to process data from the automatic collection systems, e.g., buoys, towers, automatic land stations, ships, aircraft, radars, and rawinsondes. An example of time series buoy data is shown in a later section of this Bulletin.

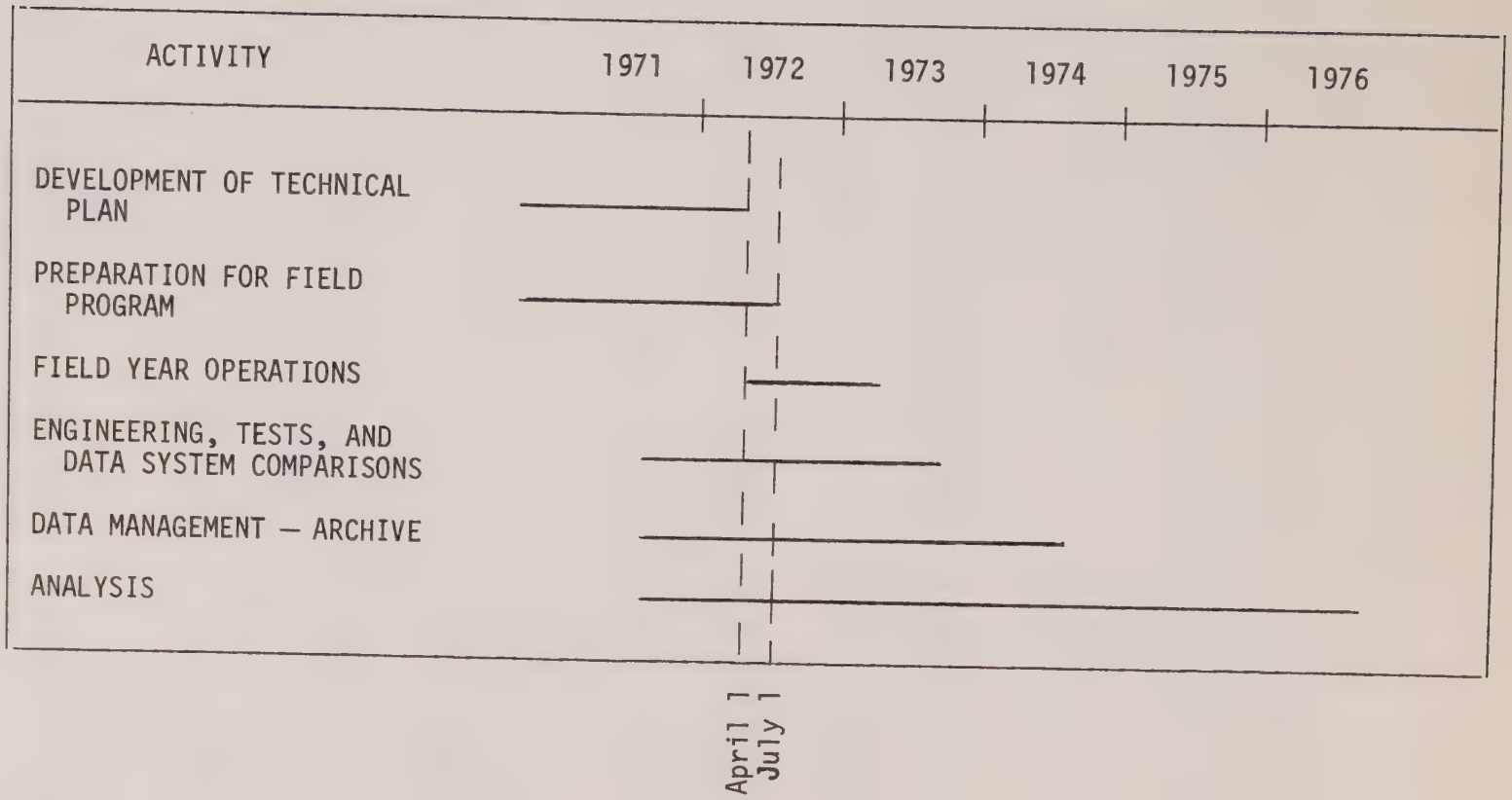

Figure 1. U.S. IFYGL schedule.

U.S. SCIENTIFIC PROGRAM

The U.S. Scientific Program was described in IFYGL Bulletin No. 3 in terms of 69 tasks distributed among eight projects. Since the start of the IFYGL field operations on April 1, 1972, work in each of the eight project areas has generally proceeded according to the Technical Plan, but there have been some delays in schedules and some difficulties have arisen in the operations of the data acquisition systems. Also presented in Bulletin No. 3 was a table relating the individual tasks to the broad project areas and to water resource management problems. Table 1 (p.93) in this issue provides the same information in corrected form and also incorporates one task that has been added since April 1.

The progress from April 1 through June 30, 1972, is presented below for each of the 70 U.S. IFYGL tasks. This information, which includes some activities in July, is based on reports requested by the IFYGL Project Office and on the IFYGL Data Catalogue monthly mailing returns. In cases where new principal investigators have been named and work direction has changed, such developments are noted.

This section also contains a discussion of activities carried out from April 1 to date as part of the Boundary Layer Project and the Synthesis Program.

Tasks

1. *Phosporus Release and Uptake by Lake Ontario Sediments*

   Principal Investigators: D.E. Armstrong and R.F. Harris[1]- University of Wisconsin.

   The first set of sediment samples was collected during the benthic cruise aboard the *Advance II* between June 22 and 30. Sediment cores were obtained at 10 stations. At all stations, cores were sectioned at 5-cm intervals and transported to Madison, Wis . , for experimental work. At eight stations, intact cores were obtained for simulation experiments. Sediment analyses and simulation experiments are in progress.

[1] R.F. Harris has been added as a joint Principal Investigator with D.E. Armstrong.

2. *Net Radiation*

Principal Investigator: M.A. Atwater - CEM

The computer programs for the initial model to analyze the cloud amounts and the radiation fluxes over the lake were checked out with climatological data. The model will generate data for a grid over the lake on a regular basis by means of land-based data input. The model will be refined from available ship data. The most important input data are cloud amounts, a major factor in computing radiation fluxes.

3. *RFF/DC-6 Boundary Layer Fluxes*

Principal Investigator: B.R. Bean - ERL/NOAA

During the May alert period the RFF aircraft 39C was flown on 9 days for a total flight time of 43 hours. Three types of missions were flown:

Intercomparison and joint missions with NCAR Buffalo (2 days).

Intercomparison with towers on Niagara Bar on flyby's (4 flights).

Flux measurements as a function of fetch, altitude, and modification by the underlying surface. Flights were from 50 to 8,000 ft over the lake, and from 1,000 to 8,000 ft over land on both sides of the lake (7 days).

Due to the very cool water temperature (2 to 4°C), evaporation was negative in most cases, i.e., rather than evaporation from the water, there was condensation from the air. Very strong temperature inversions existed over the lake but at very low altitude. Even on the downwind side of the lake the inversion appeared to be less than 200 ft.

During the June alert period the RFF aircraft 39C was flown on 8 days for a total flight time of 36 hours. The three types of missions were the same as those flown in May:

Intercomparison and joint missions (on land-lake breeze) with the NCAR Queen Air (2 days).

Intercomparison with towers on Niagara Bar on flyby's (4 flights).

Flux measurements as a function of fetch, altitude, and modification by the underlying surface.

It was found that the towers on Niagara Bar were situated in the coldest part of the lake (probably due to upwelling). The average surface temperature of the lake rose approximately 5°C since the May period.

The evaporation layer even on the downwind side of the lake was very low (under 200 ft), necessitating more low-level flights during the May period. Excessively bad weather was experienced during most of the June period. Low cloud cover, haze, rain, and poor visibility were common during this period as a result of hurricance Agnes.

4. *Nitrogen Fixation*

Principal Investigator: R. Burris - University of Wisconsin

No activity until July.

5. *Profile Mast and Tower Program*[2]

Principal Investigator: J.A. Businger - University of Washington

No field measurements were made during April through June. Preparations were continued for participation in the October alert period. Site selections were made for instrument housing on both the north and south shores. Some fast-response dry- and wet-bulb thermocouple transducers have been developed. Plans have been abandoned for using the Mentor buoy on the north side of the lake. Instead, the profile mast will be operated from the end of the Cobourg pier.

6. *Status of Lake Ontario Fish Populations*

Principal Investigator: J.F. Carr - Great Lakes Fisheries Laboratory

Two 15-day assessment fishing surveys of offshore fish stocks in Lake Ontario (Cruises II and IV), planned in cooperation with the Ontario Ministry of Natural Resources and the New York Department of Environmental Conservation, were completed. Collection of fish, water, and bottom samples for various agencies and laboratory analyses was also completed. Cruise reports covering areas of operation and fishing results were issued. Shakedown operations during Cruise II led to modifications of transect responsibilities and sampling procedures by the *Kaho* during Cruise IV in order to achieve primary objectives most

[2] Note change in title of this task.

efficiently. Major alterations in original operating plans involve elimination of a synoptic fishing approach, i.e., two vessels sampling one transect at the same time, rather than two vessels sampling different transects simultaneously or nearly so.

7. *Material Balance of Lake Ontario*

Principal Investigator: D.J. Casey - EPA

No report.

8. *Runoff*

Principal Investigator: L.T. Schutze[3]- U.S. Army Corps of Engineers

A first-cut estimate of runoff has been prepared for the U.S. land basin (12,500 sq. mi) from daily discharge records for April 1972 furnished by the U.S. Geological Survey.

9. *Evaporation (Lake-Land)*

Principal Investigator: L.T. Schutze[4]- U.S. Army Corps of Engineers

First-cut estimates of precipitation on the lake, inflow-outflow, and change in lake storage were made for April 1972. Estimates of other parameters of the lake equation are not available.

10. *Simulation Studies and Analyses Associated With the Terrestrial Water Balance*

Principal Investigator: B.G. DeCooke - U.S. Army Corps of Engineers

Activity has not yet begun.

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[3] Mr. Schutze has replaced B.G. DeCooke as Principal Investigator on this task.

[4] Mr. Schutze has replaced B.G. DeCooke as Principal Investigator on this task.

11. *Land Precipitation Data Analysis*

Principal Investigators: L.T. Schutze and R. Wilshaw[5]- U.S. Army Corps of Engineers

Investigation not begun.

12. *Transport Processes Within the Rochester Embayment of Lake Ontario*

Principal Investigator: W.H. Diment - University of Rochester

Beginning May 15, 1972, temperature, electrical conductivity, beam transmittance, and photometer observations were made weekly at 0.5- to 2-m depth intervals at 10 or more locations in the embayment. When a current meter was available, current speed and direction were also measured. Supplementary Secchi disk observations were made, and water samples were retrieved at the above depths and analyzed for conductivity, pH, chloride, and sulfate; in some cases, dissolved oxygen, fluoride, and bacterial analyses were also performed. More extensive operations were carried out in cooperation with Richard Burton, Monroe County Health Department, on June 19, when two boats obtained samples for physical, chemical, and bacterial analyses. During the period July 1 and 9, in cooperation with Jon Scott of State University of New York at Albany, a daily study of currents and the parameters mentioned above was made over a wider area of the embayment.

The discharge of the Genesee River dominates the water characteristics in the embayment. Easterly winds produce a plume to the west and westerly winds a plume to the east, the latter being usually the case. The plume is easily traceable from its turbidity and chemistry. The temperature of the Genesee relative to the lake largely determines whether river water spreads out over the lake in a thin plume (about 2 cm thick) as it did in May and June, or whether it sinks to appropriate levels in the thermocline as it did occasionally in early July.

13. *Soil Moisture and Snow Hydrology*

Principal Investigator: W. Embree - U.S. Geological Survey

Monthly soil-moisture and snow-survey data are being collected and analyzed on 11 sites in the Black River basin of New York currently maintained by the U.S. Geological Survey. Analysis of soil-moisture

[5] L.T. Schutze and R. Wilshaw have replaced B.G. DeCooke as Principal Investigators on this task.

data is providing a monthly depth-weighted total inches of water amount stored in the soil columns measured for use in estimating the monthly depth-weighted total change in soil-moisture storage for the Black River basin. Snow data analysis is providing a monthly value of total snow cover and a monthly change in snow cover, both expressed in terms of depths of water in inches over the basin. A study of these values, and of corresponding meteorological data, has begun to determine their effect on the timing and the amount of measured stream-flow, soil-moisture change, and ground-water fluctuation.

14. *Boundary Layer Structure and Mesoscale Circulation*

Principal Investigator: M.A. Estoque - University of Miami

No report.

15. *Mesoscale Simulation Studies*

Principal Investigator: M.A. Estoque - University of Miami

No report.

16. *Lake Level Transfer Across Large Lake*

Principal Investigator: C.B. Feldscher - LSC/NOAA

Operation of existing water level gages was continued and additional gages were put into operation. Final plans were made for the installation of the remainder of the gaging equipment early in July. Correlation of data from these gages with meteorological data was not possible during the reporting period. Coordination of plans for data reduction and analysis with the Canadian Principal Investigator on this task was continued.

17. *Near-Shore Ice Formation, Growth, and Decay*

Principal Investigator: A. Pavlak[6], General Electric Company

Activity has not yet begun.

[6] Mr. Pavlak has replaced L.M. Gilbert as Principal Investigator on this task.

18. *Advection Term - Energy Balance*

Principal Investigator: J. Grumblatt - LSC/NOAA

No report.

19. *Occurrence and Transport of Nutrients and Hazardous Polluting Substances in the Genesee River Basin*

Principal Investigator: L.J. Hetling - New York State Department of Environmental Conservation

Tentative sub-watershed areas with one major land use were selected from the LUNR area data land use maps. The New York State LUNR Program is a detailed inventory of the state's land use and natural resources. A field survey was made to check any changes that may have occurred since the land use photos were taken in 1968. The streams were surveyed for suitable locations of sampling stations. The final areas chosen were:

Cropland - Spring Creek
Pasture - Jaycox Creek
Brushland - East Valley Creek
Forest - Briggs Gully
High Density Residential - Dansville
Urban - Allen Creek

Two samples will be taken at each of these stations every 2 weeks for 1 year. One set of samples will be sent to Dr. G. Fred Lee. Each sample will be analyzed for total organic carbon, ammonia nitrogen, soluble phosphorus, orthophosphates, reactive silica, sulfates, chlorides, sodium, potassium, magnesium, calcium,and total iron. In addition, pH, alkalinity and temperature at these sites will be studied. The streams will be gaged at each site at the time the sample is taken.

Dr. G. Wolfgang Fuhs of the Division of Laboratories and Research, New York State Department of Health, will provide the necessary laboratory services. The U.S. Geological Survey will do the stream gaging.

20. *Boundary Layer Flux Synthesis*

Principal Investigator: J.Z. Holland - CEDDA/NOAA

Two alert periods were held - May 1 to 13 and June 11 to 24. Aircraft flight patterns were planned and executed during the two alert periods. Intercomparisons were made by NOAA aircraft with the Canadian and United States towers and the NCAR aircraft. Limited data from the U.S. buoys and NOAA aircraft are available at CEDDA, and the DECCA winds have been evaluated. An initial plan for computing fluxes based on these data has been made, but the surface data have not been reviewed or edited. "Quick-look" reviews of aircraft flux data are quite encouraging.

21. *Hazardous Material Flow*

Principal Investigator: N.A. Jaworski - EPA

No report.

22. *Remote Measurement of Chlorophyll with Lidar Fluorescent System*

Principal Investigator: H.H. Kim - NASA

The plan was to obtain chlorophyll A distribution data from designated areas by the lidar method and to evaluate the lidar performance with other correlated data obtained by surface vessels engaged in B and C and temperature transect cruises.

In accordance with the operational plan agreed upon with IFYGL authority at the May 15 visit to EPA Gross Ile Field Station in Michigan, the basic tests of the lidar system will be as follows:

(a) Measurement of chlorophyll A distribution on three 10-mi transect lines, preceding temperature cruises by the NOAA research vessels. The transect lines are located off the shorelines of Niagara Falls, Rochester, and Oswego, N.Y., respectively.

(b) Survey of a square area around one of the NOAA vessels when it is on a biological and chemical station. The three stations selected are Stations 10, 48, and 84.

An unexpected delay in receiving a pulse recorder and other components has changed scheduled participation from July-August to September-October. However, orientational helicopter overflights were made in 1 week in July. During the test flights and system checkout, the crew frequently encountered heavy fogs that created hazardous VFR operating conditions. Since the contractor's helicopter is not equipped with a DECCA navigational system, flight over a remote water station or ship would be impossible if such atmospheric conditions were to prevail during the mission.

The lidar package was improved by adding a multimode analog-to-digital converter unit and a recorder system. This automated pulse recording system is necessary for field operation. A trial test flight and system check was performed from July 13 to July 17 off the near-shore area of Rochester Harbor, N.Y.

23. *Inflow/Outflow Term-Terrestrial Water Budget*

Principal Investigator: I.M. Korkigian - U.S. Army Corps of Engineers

During the April-June period, the vertical distribution of water temperatures and velocities was measured at the north and south channels of the St. Lawrence River around Wolfe Island. Together with the Water Survey of Canada, the Corps of Engineers measured the discharge of the St. Lawrence below the Saunders-Moses powerhouses at Cornwall, Ontario. This project was undertaken for the St. Lawrence River Board's River Gaging Committee; however, the results lend themselves to an assessment of the use of power plant discharges for determining Lake Ontario outflow. Toward the end of the quarter, the U.S. field party moved to the vicinity of Iroquois Dam where a new section was established, and the weir on the Oswagatchie River at Ogdensburg was calibrated. The Canadian field party moved to the lower Niagara River in preparation for the simultaneous inflow-outflow measurements to be obtained in July.

Due to destruction of the transducer cable leading from the U.S. transducer to the instrumentation in Canada, the leading-edge sonic flowmeter located in the upper Niagara River could not be calibrated. Therefore, measurements of the St. Lawrence River below the powerhouses at Cornwall, Ontario, previously programmed for July 1972, were reprogrammed and completed during June 1972.

24. *Use of an Unsteady-State Flow Model To Compute Continuous Flow*

Principal Investigator: I.M. Korkigian - U.S. Army Corps of Engineers

Work has not begun.

25. *Radiant Power, Temperature, and Water Vapor Profiles Over Lake Ontario*

Principal Investigator: P.M. Kuhn - ERL/NOAA

A radiation flight over Lake Ontario was made on July 5, 1972, between 1500 and 1700 EDT. The surface temperature was mapped with a thermal imager. In addition, the radiation budget of the lake, upstream, over, and downstream, was obtained in detail.

Research preparations for the fall activities are proceeding as planned. NASA Ames Research Center CV-990 flight plans remain in doubt, except for occasional overflights, because of funding.

26. *Algal Nutrient Availability and Limitation on Lake Ontario*

Principal Investigators: G.F. Lee and W. Cowen[7]- University of Wisconsin

Procedures for the assessment of the nitrogen and phosphorus nutritional status of Lake Ontario *Cladophora* were tested on algae analyzed in Rochester, N.Y., and after shipment to Madison, Wis. As a result of these studies, the decision was made to analyze the *Cladophora* in laboratories in Buffalo and Oswego, N.Y., for extractable phosphorus and phosphatase activity. Rates of ammonia uptake will be run aboard SUNY Buffalo and Oswego ships. *Cladophora* samples from the New York shore have been analyzed for total cell nitrogen and phosphorus in preparation for long-term incubation of the algae in darkness in lake water, to follow the rates of nutrient release from the decaying cells. The bioassay, by using the standard Provisional Algal Assay Procedure (PAAP), of limiting nutrients in the near-shore and deep water of Lake Ontario has begun. These studies will be continued into the next quarter, along with research on the availability of nutrients from the particulate matter entering the lake via the Niagara, Genesee, Oswego, and Black Rivers.

Progress in these studies has been hindered to some degree by the problem of extremely bad weather on Lake Ontario, making it impossible to collect the near-shore and open water samples requested. This has meant that we have been unable to process the number of samples originally planned.

27. *Wave Studies*

Principal Investigator: P.C. Liu - LSC/NOAA

Five waveriders were deployed on May 10 and 12. While the three waveriders near U.S. buoys 14, 19, and 20 are operating properly, there have been problems with the other two. The one near U.S. buoy 12 has been hampered by interference in recording, and the one near U.S. buoy 17 has a defective radio receiver. Both problems are expected to be solved in early July.

Continuously recorded analog magnetic tapes from the three operating waveriders are analyzed as soon as they are received in Detroit. The analyses are made with a Federal Scientific Corporation's UA-10 Ubiquitous Spectrum Analyzer and a 1010 Ubiquitous Spectrum Averager. Four analyses at 6-hour intervals are made daily. The resulting wave energy spectra, each representing 16 averaged spectra over a 2-hour period, are plotted automatically by an x-y plotter. The frequency of analysis can be

[7] W. Cowen has been added as a Principal Investigator on this task.

increased if necessary. The tropical storm Agnes which reached Lake Ontario on June 22 and 23 has been analyzed in detail.

Installation of the Lake Survey Center research tower and its instrumentation with a wind anemometer and an array of four staff and two pressure wave gages was completed in June. The multiple channel recordings, which are made for a duration of 30 min every 2 hours, were started at the end of June.

28. *Cloud Climatology*

Principal Investigator: W.A. Lyons - University of Wisconsin, Milwaukee

Four 35-mm all-sky camera systems were designed and constructed. These, along with the previously built 16-mm system, were deployed during the second week of June 1972. In addition, two Kipp & Zonen CM6 solarimeters were procured and sent into the field. Observation sites include:

McMaster University, Hamilton, Ontario	35-mm camera
IFYGL Field Headquarters, Rochester, N.Y.	35-mm camera
State University of New York at Oswego, N.Y.	35-mm camera
AES Station, Peterboro, Ontario	35-mm camera
AES Training Station, Scarborough, Ontario	16-mm camera
Griffiths AFB, Rome, N.Y.	Solarimeter
IFYGL Field Headquarters, Rochester, N.Y.	Solarimeter

The camera installations have all been inoperative after an initial period of 1 to 2 weeks due to a series of mechanical problems. Solarimeter traces from Rome and ship cloud panoramics are now starting to arrive and be analyzed.

29. *Zooplankton Production in Lake Ontario as Influenced by Environmental Perturbations*

Principal Investigator: D.C. McNaught, State University of New York at Albany

The mapping of zooplankton distributions in the Great Lakes is necessary for evaluating the degree of eutrophication of these vital

resources. A new acoustical sampling system has been designed and tested by Robert Zeh at the State University of New York at Albany. It will automatically provide an x-y plot and paper tape record of sound backscattered from zooplankters as small as 0.8 mm. Zooplankton concentrations were sampled with this device on the NOAA vessel *Researcher* during the May 15-19 cruise at 34 stations, with backscattering from two frequencies (100 samples) recorded on an x-y plotter. Similar x-y records, augmented with teletype printout and paper tape, were obtained during the June 12-15 cruise at 15 stations (50 records) before equipment failure. To verify these first acoustical plots, zooplankton were collected with nets and preserved at a number of stations and depths (224 samples at 34 stations on the May 15-19 cruise and 399 samples at 61 stations on the June 12-15 cruise).

Interpretation of both the acoustical and biological data will be aided by computer processing, which has begun in the laboratory. A computer program has been written for processing acoustical data from paper tape. The ultimate goal of this program is to understand how increased pollution has altered the zooplankton populations of the lake, and to develop predictive capabilities to head off pollution problems as they develop.

30. *Change in Lake Storage Term - Terrestrial Water Budget*

Principal Investigator: R. Wilshaw[8]- U.S. Army Corps of Engineers

Nineteen shore-based level gages were installed prior to, and early in, the quarter. By the end of June, plans for installing water level gages on offshore towers were begun with an anticipated July completion date. Data for April and May were collected, digitized, and transmitted to the project investigators. A trial computer program was written to tabulate hourly water level readings and compute an end-of-week and end-of-month mean lake level. Further programming is underway to analyze data for gage network optimization and study of irregular lake level fluctuations.

A field crew was dispatched to Olcott and Braddock Point to equip newly installed offshore towers with water level gages. This work should be completed early next quarter. An outline describing a method of analyzing the various gage networks and effects of irregular lake fluctuations is being drafted. The plan is to accomplish this phase of the project in cooperation with the Canadians.

R. Wilshaw has replaced E. Megerian as Principal Investigator on this task.

31. *Soil Moisture*

Principal Investigator: L.T. Schutze[9] - U.S. Army Corps of Engineers

Work has not begun.

32. *Testing of COE (Corps of Engineers) Lake Levels Model*

Principal Investigator: E. Megerian - U.S. Army Corps of Engineers

Work on this task will start about April 1973.

33. *Near-Shore Study of Eastern Lake Ontario*

Principal Investigator: R.B. Moore - State University of New York at Oswego

The inshore waters of Lake Ontario receive pollutants from lakeside communities, and from inland via major rivers. Identification of water quality in these areas is possible through analysis of zooplankton concentrations. From May 30 through June 20, 217 zooplankton samples were collected from these areas and are being processed. Data will be analyzed by means of newly developed computer programs.

34. *Internal Waves - Transects Program - Interpretation of Whole-Basin Oscillations*

Principal Investigator: C.H. Mortimer - University of Wisconsin, Milwaukee

The *Researcher* and *Advance II* began transects on July 24. The *Researcher* monitored temperature versus depth along the Braddock Point - Presqu'ile section using the undulating "fish", a sensor package developed at the Center for Great Lakes Studies in Milwaukee. The standard operating procedure was to cause the "fish" to dive into the deep, cold layers ($\sim$ 40 m) and then rise up near the surface ($\sim$ 3 m) with a cycle time of about one dive per 10 or 15 min. Between dives the "fish" was towed at a constant depth calculated to lie in the middle of the thermocline.

The temperature and depth information were recorded digitally on magnetic tape. Occasionally ship's position and surface temperature as determined from the *Researcher* DAS system, and GMT time from the SAM

[9] L.T. Schutze has replaced E. Megerian as Principal Investigator on this task.

clock, were manually keyed onto the tape. When the ship passed instrumented buoys TI-16, OC 10A, and OC 9A, this information was also keyed in. During each dive x-y plots of temperature versus depth were obtained.

The *Researcher* ended its 20th transect on July 28. A total of about 68 hours of recorded data were collected with the undulating "fish" system. There were 383 dives in all. There were also 45 mechanical BT casts and two XBT casts.

The *Advance II* ran its transects between Oswego, N.Y., and Prince Edward Point, Ontario. A total of about 310 mechanical BT casts were made in the vicinity of 18 fixed stations along the transect line.

A preliminary inspection of the data from both ships showed a shallow, diffuse thermocline along the north shore and a deep, very sharp thermocline along the south shore. This upwelling and downwelling pattern is the expected result of a persistent west wind.

On several occasions the *Researcher* passed through thermal "fronts" lying across the transect. The fronts showed up both in surface temperature and in the subsurface structure. They were also sometimes accompanied by prominent surface "slicks".

35. *Pontoporeia affinis and Other Benthos in Lake Ontario*

Principal Investigator: S.C. Mosley - University of Michigan

An epibenthic sled of original design has been constructed and field tested in Lakes Michigan and Ontario. Minor alterations are continuing. Forty-two samples have been collected at 29 IFYGL fishing stations on six transects ranging from 5 to 40 fathoms in depth; 13 stations have been sampled twice. Our tests for the randomness of the Folsom plankton sample splitter have proven its usefulness for larger organisms. Sled samples contain large numbers of other organisms, especially other crustaceans, flatworms, and molluscs. Two sets of comparative samples with the ponar grab and the epibenthic sled at multiple depths have been taken and partly processed.

36. *Pan Evaporation Project*

Principal Investigator: T.J. Nordenson - NWS/NOAA

Six standard Class A evaporation stations were installed during the quarter. The equipment at these stations also includes the National Weather Service experimental insulated evaporimeter (designated X-3). The sites of the stations are as follows: Fort Niagara, Hilton (near Rochester), and Stony Point, N.Y.; Woodbridge Research Station, Kingston

Airport, and Trenton Airport, Ontario. At the Fort Niagara site, an Eppley pyranometer and pyrgeometer were installed as a check on radiation measurements at the nearby IFYGL land meteorological station. Observations are going well at all stations. A computer program has been completed for tabulations of the basic data.

37. *Simulation Studies and Other Analyses Associated With U.S. Water Movements Projects*

Principal Investigators: J.P. Pandolfo and C.A. Jacobs - CEM

Extensive changes in an existing three-dimensional air/sea boundary layer model have been made. Progress is underway on testing and evaluating the modified interface and boundary conditions that allow a free surface to the water layer and impose a nonslip, rigid, sloping boundary at the lateral and lower boundaries with specified dependent variables at all rigid water-land boundaries. The prediction of the dependent variables in the atmospheric boundary layer over land is made at grid points that lie in planes parallel to the land topography. This provides for the introduction of topographical effects in the equations of motion. In addition, a series of one-dimensional simulations, for the months of March, July, and October, have been completed. Boundary conditions and initial conditions used in these simulations were primarily based on climatological data obtained from atlases and reports. These results have been analyzed and are being prepared for a report.

38. *Tower Program*

Principal Investigator: H.A. Panofsky - Pennsylvania State University

Instruments were operated successfully on the Niagara Bar tower for the week of June 12-18. This was essentially a shakedown run, and although records were obtained for a week they will probably not be analyzed in detail because the wind blew through the barge before reaching the anemometers. The main analysis will be based on the August runs, in accordance with the original plan.

39. *Airborne Snow Reconnaissance*

Principal Investigator: E. Peck - NWS/NOAA

Collection of background radiation data for the project flight lines was scheduled for early June. Success of the background monitoring mission was limited to one benchmark flight line in the Lake Cayuga - Lake Owasco vicinity due to inclement weather conditions. The background measurement mission has been rescheduled for early fall 1972.

Optical Properties of Lake Ontario

Principal Investigator: K.R. Piech - Cornell Aeronautical Laboratory

The objectives of this task are: (1) measuring the optical properties of Lake Ontario, especially with reference to spatial and temporal characteristics and photic zone definition; (2) providing inputs to the lake heat budget and biological-chemical studies; and (3) comparing and evaluating three techniques for optical turbidity measurements, i.e., Secchi disk, irradiance meter/transmissometer, and aerial photographic photometry.

During April-June, equipment was selected, purchased, and modified; a shakedown cruise was conducted; and plans for the aerial measurement program were established.

Four data cruises were completed as of July 24. The transmissometer and downwelling irradiance systems are operating successfully. Three aerial overflights have been made. Imagery from the first has undergone "first-look" reduction and calibration. These initial results indicate the aerial data should be very useful in assessing the optical properties of the lake.

41. *Storage Term - Energy Balance Program*

Principal Investigator: A.P. Pinsak - LSC/NOAA

No report.

42. *Sensible and Latent Heat Flux*

Principal Investigator: A.P. Pinsak - LSC/NOAA

No report.

43. *Thermal Characteristics of Lake Ontario and Advection Within the Lake*

Principal Investigator: A.P. Pinsak - LSC/NOAA

No report.

44. *Oswego Harbor Studies*

Principal Investigator: A.P. Pinsak - LSC/NOAA

No report.

45. *Mapping of Standing Water and Terrain Conditions With Remote Sensor Data*

Principal Investigator: F.C. Polcyn - University of Michigan

No report.

46. *Remote Sensing Program for the Determination of Cladophora Distribution*

Principal Investigators: F.C. Polcyn and C.T. Wezernak - University of Michigan

Multispectral and photographic coverage was obtained on June 17 and June 20, 1972, from the Willow Run Laboratories' remote sensing aircraft operating at an altitude of 1,300 ft. Data were collected along the shore of Lake Ontario covering the area from Toronto to Niagara and then along the U.S. shore to Stony Point at the eastern end of the lake. The scanner and photographic data collected are being processed. Work in the next quarter will include an examination of all data and formulation of plans for data processing and further aircraft coverage.

47. *Remote Sensing Study of Suspended Inputs Into Lake Ontario*

Principal Investigators: F.C. Polcyn and C.T. Wezernak - University of Michigan

No report.

48. *Island - Land Precipitation Data Analysis*

Principal Investigator: F.H. Quinn - LSC/NOAA

Precipitation data were collected continuously at the six Lake Ontario stations. Data tapes for the period November 18, 1971, to April 13, 1972, were received on May 26 and are being reduced. A Thessen polygon network was established for all National Weather Service precipitation stations in the Lake Ontario drainage basin. The data collection and reduction programs are on schedule. Data collection will continue, and updated precipitation summary sheets will soon be available to those interested.

49. *Lake Circulation, Including Internal Waves and Storm Surges*

Principal Investigator: D.B. Rao - University of Wisconsin, Milwaukee

Programs are almost complete on the following: (a) a storm surge model of Lake Ontario for a single-layer case, (b) steady-state circulations in a two-layer lake and (c) a time-dependent two-layer model to examine the character of internal waves excited by wind stresses. Initial

tests are being made based on hypothetical wind stresses. In (a) and (b) above, lake topography and shape are taken into account. In (c), the lake is approximated by a close-fitting rectangle with vertical walls, so that the topography is slightly altered near the shores. Over the remainder of the lake, the topography is left unchanged. Rotation is taken into account in all three cases by using a constant Coriolis parameter. The bottom (and interfacial) stress is formulated by means of linear representations based on volume transports.

During the coming quarter, available data from Field Year observations on water levels, currents, winds, and temperature will be gathered for input into the numerical models.

50. *Atmospheric Water Balance*

Principal Investigator: E.M. Rasmusson - CEDDA/NOAA

Work has progressed in modifying the basic BOMEX analysis scheme for use in this program. "First-look" analyses will probably be made by least squares fitting of plane surfaces to the basic data (e.g., $Q(x,y,p^*,t) = a(p^*,t) + b(p^*,t)\,x + c(p^*,t)\,y$. A more sophisticated analysis scheme, involving the use of orthogonal functions (generated by means of the Gram-Schmidt process) to fit the basic fields, is now being developed.

51. *Evaporation Synthesis*

Principal Investigator: E.M. Rasmusson - CEDDA/NOAA

This task involves the synthesis of evaporation estimates obtained from scientific analyses carried out by a number of other investigators. Little activity is therefore anticipated before the latter part of 1972.

52. *Ground-Water Flux and Land Storage*

Principal Investigator: E.C. Rhodehamel - U.S. Geological Survey

Hydraulic conductivities (permeabilities) available in published and industrial reports have been assembled for five lakefront locations. Most values are for the somewhat more permeable, but relatively thin, overburden materials. Permeabilities of the unweathered bedrock, except the limestone aquifer along the east shore, indicate that no significant quantities of water reach the lake. Lacking data to the contrary, the yield from the remaining unweathered bedrock sources apparently can be ignored. Preliminary computations of ground-water flux to the lake show a lower value than that reported for the Canadian side, but of the same order of magnitude. The yield from several buried bedrock channels

filled with Pleistocene deposits of undetermined nature is yet to be assessed and should provide a better estimate of the direct ground-water flux to Lake Ontario.

The initial computation of direct ground-water inflow to Lake Ontario is not considered satisfactory; better definition of the areas involved and the effects of buried channels is required to derive a more accurate estimate.

Thirty-nine water wells, distributed throughout the 12,500-sq. mi basin, are measured either weekly or monthly. Five are bedrock wells, 15 are in till, and 18 are exposed to sand and gravel aquifers. Seven of these are equipped with continuous water stage recorders to provide a daily regional coverage for developing a monthly measurement of storage change. The well at 43°13'N, 78°55'W near Ransomville, N.Y., is being considered for installation of a continuous analog recorder to bolster our ground-water data from the western part of New York State. Date for installation is late June or early July 1972.

The areal extent of permeable materials (fluvial and deltaic sand and gravel and coarse gravelly tills) and poorly permeable materials (lacustrine clay beds, clayey tills, and bedrock) has been estimated from a 2,500-sq. mi representative sample (20 percent of total area). Specific-yield values for these materials have been determined either in the field or from published data. Where data were missing, specific yields were estimated. These three sets of data permit determination of an integrated, areally weighted, monthly average of ground-water storage change throughout the basin.

Ground-water levels this spring and early summer were the highest ever recorded, as a result of a combination of heavy snow melt and wet spring conditions. Normal soil moisture and ground-water storage depletions for the summer months have been interrupted by the heavy rainfalls of extra-tropical storm Agnes, which hit western New York State on June 20-23. At that time, ground-water levels rose appreciably and soil-moisture deficits were generally satisfied throughout the Lake Ontario drainage basin in New York State.

53. *Spring Algal Blooms*

Principal Investigator: A. Robertson - IFYGL Project Office/NOAA

All sampling has been completed and analysis is well underway. Due to a variety of problems a substantial fraction of the planned sampling was omitted. Two of the eight cruises were dropped. On the remaining cruises the chlorophyll samples from only three depths will be analyzed rather than the seven depths planned. Lesser amounts of the other types of samples will not be analyzed.

54. *Ice Studies for Storage Term - Energy Balance*

Principal Investigator: F.H. Quinn[10] - LSC/NOAA

Meteorological instruments were installed in the vicinity of Mexico Bay on the southeast shore of Lake Ontario on May 24 and 25, 1972. Data being collected include air temperature, water temperature, direct solar radiation, and wind speed and direction. Data for June were limited due to instrument adjustment during the shakedown period.

55. *Lagrangian Current Observations*

Principal Investigator: J.H. Saylor - LSC/NOAA

Current patterns were measured across the thermal boundary dividing warming inshore lake water from colder water offshore during the planned 4-week observation period, mid-May to mid-June. The studies were conducted along the United States and Canadian coasts in the western third of Lake Ontario. The currents were measured by tracking the drift of a network of 10 drogues with the navigation systems on the *Shenehon*. The thermal front during the 4-week period varied in position from 4 to 10 mi offshore. Many profiles of velocity shear and of water temperature distribution across the thermal boundary region were obtained. In July, currents were measured on 17 of 21 scheduled observation days. Intense eastward baroclinic flows along the south shore were noted to persist the entire month.

Shortly after the start of the investigative program, it was observed that the spatial and temporal variability of the current and temperature structure was so great as to make current metering from an anchored vessel of little value. The currents were determined by tracking the drift of a network of drogues, with current meters used only for intercomparison of velocities determined by the two methods. The program was successful, and many interesting and informative measurements were obtained.

56. *Circulation of Lake Ontario*

Principal Investigator: J.H. Saylor - LSC/NOAA

Discussions of data processing and format requirements were held with the LSC Computer Division. Its heavy commitments to the real-time data collection efforts associated with the Texas Instruments system

[10] F.H. Quinn has replaced D.R. Rondy as Principal Investigator on this task.

have precluded development of the necessary data processing software to our task specifications. The data collection network was not deployed fully until June, and at this time only cursory examinations of the current meter outputs have been made.

Because of the June deployment of the majority of the U.S. buoys and the resulting longer wait to get a look at the data in some meaningful format, editing and verification of the data, as well as meaningful interpretation and putting together of results, will be delayed much longer than envisioned earlier.

57. *Phytoplankton Nutrient Bioassays in the Great Lakes*

Principal Investigator: C. Schelske - University of Michigan

No report.

58. *Runoff Term of Terrestrial Water Budget*

Principal Investigator: G.K. Schultz - U.S. Geological Survey

Measurements were made and ratings developed for the representative streams in the 26 subdivided areas of the Lake Ontario plain. Peak marks of the spring runoff were used to estimate the high-water part of the rating. Stages were obtained at two separate times during May and June. Another stream was added to the network. The drainage areas and cubic-feet-per-square-mile (cfsm) values of the measurements were determined for most of the streams. The cfsm approach is used to estimate flow of the ungaged areas.

We have not started to estimate flow of the ungaged areas yet, but are determining the cfsm values and experimenting with those gaged areas that should be used with the ungaged areas for correlation.

59. *Coastal Chain Program*

Principal Investigator: J.T. Scott - State University of New York at Albany

During April we prepared for the May 15-June 15 alert period. Remaining equipment was ordered and boats rented and prepared. The coastal chain buoys were set between May 10 and 14 except for two buoys on the Oswego chain which were set later. Boat trouble and weather were our main difficulties in operating the coastal chains. However, with the exception of the Rochester chain, the percentage of successful data days was about normal. The Rochester data bank was only 65 percent of possible days because of late delivery of our rented boat. The coastal chain data contain three interesting spring events for all three chains.

The data collection problems for the spot measurements can be gleaned from the table below, which summarizes the coastal chain data record and causes of unusable runs.*

	Oswego	Rochester	Olcott
Days of alert	33	32	32
Possible runs	66	64	64
Runs attempted	38	28	40
Usable runs completed	37**	22	36
Usable full days completed	14	7	16
Usable days (one or more usable runs)	22	15	21
Unusable runs	29	42	28
Reasons:			
Weather	17	16	25
Fog	10	7	11
Rough sea or storm	7	9	14
Equipment	10	30	0
Meters	0	5	0
Boats	10	25	0
Crew	2	1	0
Other	0	2	3

* A "usable run" is defined as one of the twice daily samplings of all buoys on a chain in which the plots of temperature and current vectors will provide useful information. This is generally 80 to 100 percent of the stations but may be as low as 60 percent when spatially continuous or for certain interesting events. "Unusable runs" contain less than 60 percent of data or are for periods temporally inconsistent with the basic data (a scattered observation).

** Meter speed sensor inoperable on 11 runs (6 days).

60. *Analysis of Phytoplankton Composition and Abundance*

Principal Investigator: E.F. Stoermer - University of Michigan

Thirty-four of 60 planned stations were completed in June. Fog and haze severely curtailed planned sample acquisition.

61. *Clouds, Ice and Surface Temperature*

Principal Investigator: A.E. Strong - NESS/NOAA

ERTS-A became ERTS-1 after successful launch on July 24, 1972. Imagery is excellent. Preparations are being made for first coverage of the Great Lakes, beginning with Lake Ontario on July 31 and lasting through August 2.

ERTS-1 1972 visitations of Lake Ontario are as follows:

August 1-2
August 19-20
September 6-7
September 24-25
October 12-13
October 17-18
October 30-31
December 5-6
December 23-24

All are at 10 AM local time. The first of each 2 days will provide coverage of eastern half; second day, of western half. Times may be in error by $\pm$ 1 day, especially later in the year, because of orbital adjustments.

Data available are as follows:

(a) Clouds: ESSA 9, ATS-3, ESSA 8 (APT) photographs on file at NESS.

(b) Ice: Same as above.

(c) Surface temperature: None available (ITOS-D scheduled launch is October 1972).

62. *Analysis and Model of the Impact of Discharges From the Niagara and Genesee Rivers on Near-shore Biology and Chemistry*

Principal Investigator: R.A. Sweeney - State University of New York at Buffalo

The field phase of the project was delayed by late funding and by weather that allowed the completion of only three rather than six near-shore sampling runs. The laboratory phase of the study is on schedule. Tasks completed between April 1 and June 30, 1972, are shown in the table that follows.

Week	H_2O chemistry	Sediment chemistry	Primary product.	Zoo-plankton	Phyto-plankton	Benthos	*Cladophora*	River mouths	Physical parameters
April 17	X	X	X	X	X	X			X
April 24									
May 1									
May 8	X		X	X	X				X
May 22									
May 29							X		
June 5							X		
June 12							X		
June 19	X	X	X	X		X	X		X
June 26									

All the chemical analyses on sediment have been completed and are ready for input to STORET. Preserved benthos, phytoplankton, and zooplankton are being identified and counted. A total of 1,685 water samples were delivered to the EPA Chemistry Laboratory in Rochester. Physical data are being readied for input to STORET.

63. *NCAR/DRI - Buffalo Program*

Principal Investigator: J.W. Telford - Desert Research Institute, University of Nevada

No report.

64. *Mathematical Modeling of Eutrophication of Large Lakes*

Principal Investigator: R.V. Thomann - Manhattan College

The primary effort during the first quarter was the collection of the necessary input data. Data were obtained from CCIW and EPA. A literature review was begun to document the available information on Lake Ontario that is to serve as a data pool.

The CCIW data together with available retrieval programs have been made operational on the CDC 6600. The programs are now being tested with certain display programs. Contour plots of variables at a given depth and time period have been produced as test cases. The EPA data were retrieved by means of STORET, and a Water Quality Inventory listing summary data at the stations was obtained.

65. *Cladophora Nutrient Bioassay*

Principal Investigators: G.F. Lee and W. Cowen[11]- University of Wisconsin

See report for Task 26.

66. *Sediment Oxygen Demand*

Principal Investigator: N.A. Thomas - EPA

The testing of equipment proceeded with so few problems that sediment oxygen demand rates were obtained in eight areas of the lake. Scuba divers photographed the benthic chamber and made observations of the sediments.

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[11] This task is a part of Task 26 being conducted by G.F. Lee and W. Cowen rather than by N.A. Thomas as indicated in IFYGL Bulletin No. 3.

67. *Main Lake Macrobenthos*

Principal Investigator: N.A. Thomas - EPA

The first of two cruises was completed, with approximately 50 percent of the stations being sampled. Three samples of benthos were collected at each station. In addition, sediment samples for pesticide, chemical, and radiological analysis were collected at each station.

68. *Exploration of Halogenated and Related Hazardous Chemicals in Lake Ontario*

Principal Investigator: G.D. Veith - University of Wisconsin

The reporting period has been devoted to familiarization with established analytical procedures and investigation of new applications and procedures in preparation for the analysis of extractable organics from fish, sediment, *Cladophora*, plankton, benthos, and water samples to be secured during the next quarter.

We have obtained data leading to tentatively outlined cleanup procedures for water and plankton extracts in addition to information leading to procedures for extracting organics from water samples via coated polyurethane plugs. We have also begun analysis of a few Lake Ontario fish samples and a *Cladophora* sample recently obtained.

69. *Basin Precipitation - Land and Lake*

Principal Investigator: J.W. Wilson - CEM

Weather radar data collections were begun by April 1 at all three radar sites (Buffalo, Oswego, and Woodbridge). Because of a variety of problems at these sites, data collected during April will be of limited usefulness in deriving precipitation amounts. The quality of the data has improved considerably since April, and much of it should be quite useful in deriving precipitation totals during the very wet months of May and June. Data collections began at the Rochester rain gage network by April 1 and at the Bowmanville network by late April. In addition, a raindrop distrometer was installed within the Bowmanville network. Computer processing of the radar data to derive hourly rainfall totals was tested and should become routine during July. Studies to integrate data from all three radars and all precipitation gages will be started during the next quarter. To help ensure more accurate snowfall measurements, an effort will be made to install a number of surface gages well protected from the wind at various distances from the lake and the radars.

70. *Evaluation of ERTS Data for Certain Hydrological Uses*[12]

Principal Investigators: D.R. Wiesnet and D.F. McGinnis - National Environmental Satellite Service, NOAA, Suitland, Maryland 20023, Tel: (301) 763-5981

The objective of this task is to assess, in a quantitative way, the ERTS data for a temperate region lake and its drainage basin in terms of hydrologic information content, relating ground truth to spectral band, ground resolution, etc. Coincident use of ITOS-D imagery and data will permit evaluation of the effect of the 18-day revisit cycle on hydrologic phenomenologic monitoring.

A remote sensing experiment for soil moisture was flown south of Auburn, N.Y., over a NOAA test site on June 14 and 16, 1972. Extensive ground measurements of soil moisture and soil temperature were taken simultaneously with airborne multifrequency microwave profiles and photography. Simultaneous overflight by AEC's airborne radiological monitoring system (ARMS) was made on June 16. Although a telespectroradiometer and a four-band camera were scheduled to be flown, they were abandoned at the last minute because their position in the aircraft caused an aerodynamically undesirable shift in the center of gravity of the aircraft.

Establishment of soil-moisture and snow-moisture "baselines" for comparison of ERTS-1 imagery to ground truth is a vital prerequisite to this project.

[12] This is a new task, which was added after April 1, 1972.

Table 1. Tasks, projects, and water resources management problem areas

SYNTHESIS PROGRAM	PROJECTS	1. TERRESTRIAL WATER BALANCE	2. ATMOSPHERIC WATER BALANCE	3. EVAPORATION SYNTHESIS	4. LAKE HEAT BALANCE	5. LAKE CHEMISTRY AND BIOLOGY	6. WATER MOVEMENT	7. ATMOSPHERIC BOUNDARY LAYER	8. SIMULATION
WATER QUALITY		X			X	X	X	X	X
WATER QUANTITY		X	X	X			X	X	X
OTHER ENVIRONMENTALLY SENSITIVE OPERATIONS			X		X		X	X	X
TASKS									
1. PHOSPHORUS SEDIMENTS						X			
2. NET RADIATION					X	X	X		
3. RFF/DC-6 BOUNDARY LAYER FLUXES				X				X	
4. NITROGEN FIXATION						X			
5. PROFILE MAST AND TOWER PROGRAM								X	
6. FISH POPULATIONS						X			
7. MATERIALS BALANCE						X			
8. RUNOFF		X				X			
9. EVAPORATION - TERRESTRIAL WATER BALANCE		X		X					
10. TERRESTRIAL WATER BALANCE ANALYSIS		X							
11. LAND PRECIPITATION		X							
12. TRANSPORT IN ROCHESTER EMBAYMENT						X			
13. SOIL MOISTURE AND SNOW HYDROLOGY		X							
14. MESOSCALE CIRCULATION								X	
15. MESOSCALE SIMULATION								X	X
16. LAKE LEVEL TRANSFER		X							
17. NEAR-SHORE ICE					X		X		

Table 1. Tasks, projects, and water resources management problem areas (continued)

SYNTHESIS PROGRAM	WATER QUALITY	X			X	X	X	X	X
	WATER QUANTITY	X	X	X			X	X	X
	OTHER ENVIRONMENTALLY SENSITIVE OPERATIONS		X		X		X	X	X
	PROJECTS	1. TERRESTRIAL WATER BALANCE	2. ATMOSPHERIC WATER BALANCE	3. EVAPORATION SYNTHESIS	4. LAKE HEAT BALANCE	5. LAKE CHEMISTRY AND BIOLOGY	6. WATER MOVEMENT	7. ATMOSPHERIC BOUNDARY LAYER	8. SIMULATION
TASKS	18. ADVECTION TERM - ENERGY BALANCE				X				
	19. GENESEE MATERIALS BALANCE					X			
	20. BOUNDARY LAYER FLUX SYNTHESIS			X				X	
	21. HAZARDOUS MATERIAL FLOW					X			
	22. CHLOROPHYLL - LIDAR MEASUREMENTS					X			
	23. TERRESTRIAL WATER BALANCE - INFLOW/OUTFLOW	X							
	24. FLOW MODEL	X							
	25. RADIATION, TEMPERATURE, & WATER VAPOR PROFILES							X	
	26. ALGAL NUTRIENT STUDIES					X			
	27. WAVE STUDIES						X		
	28. CLOUD CLIMATOLOGY		X		X				
	29. ZOOPLANKTON PRODUCTION					X			
	30. TERRESTRIAL WATER BALANCE - LAKE STORAGE	X							
	31. TERRESTRIAL WATER BALANCE - SOIL MOISTURE	X							
	32. LAKE LEVELS MODEL	X							

Table 1. Tasks, projects, and water resources management problem areas (continued)

SYNTHESIS PROGRAM		1. TERRESTRIAL WATER BALANCE	2. ATMOSPHERIC WATER BALANCE	3. EVAPORATION SYNTHESIS	4. LAKE HEAT BALANCE	5. LAKE CHEMISTRY AND BIOLOGY	6. WATER MOVEMENT	7. ATMOSPHERIC BOUNDARY LAYER	8. SIMULATION
	WATER QUALITY	X			X	X	X	X	X
	WATER QUANTITY	X	X	X			X	X	X
	OTHER ENVIRONMENTALLY SENSITIVE OPERATIONS		X		X		X	X	X
TASKS		PROJECTS							
	33. EASTERN NEAR SHORE					X			
	34. INTERNAL WAVES						X		
	35. *PONTOPOREIA AFFINIS* AND OTHER BENTHOS					X			
	36. PAN EVAPORATION			X					
	37. WATER MOVEMENTS						X		X
	38. TOWER PROGRAM							X	
	39. AIRBORNE SNOW RECONNAISSANCE	X							
	40. OPTICAL PROPERTIES				X				
	41. STORAGE TERM - ENERGY BALANCE				X				
	42. SENSIBLE AND LATENT HEAT FLUX				X				
	43. THERMAL CHARACTERISTICS AND ADVECTION						X		
	44. OSWEGO HARBOR STUDIES					X			
	45. REMOTE SENSING - STANDING WATER	X							
	46. REMOTE SENSING - *CLADOPHORA*					X			
	47. REMOTE SENSING - SUSPENDED SEDIMENTS						X		

Table 1. Tasks, projects, and water resources management problem areas (continued)

SYNTHESIS PROGRAM	WATER QUALITY	X			X	X	X	X	X
	WATER QUANTITY	X	X	X			X	X	X
	OTHER ENVIRONMENTALLY SENSITIVE OPERATIONS		X		X		X	X	X
	PROJECTS	1. TERRESTRIAL WATER BALANCE	2. ATMOSPHERIC WATER BALANCE	3. EVAPORATION SYNTHESIS	4. LAKE HEAT BALANCE	5. LAKE CHEMISTRY AND BIOLOGY	6. WATER MOVEMENT	7. ATMOSPHERIC BOUNDARY LAYER	8. SIMULATION
TASKS	48. ISLAND/LAND PRECIPITATION	X							
	49. LAKE CIRCULATION						X		X
	50. ATMOSPHERIC WATER BALANCE		X						
	51. EVAPORATION SYNTHESIS			X					
	52. TERRESTRIAL WATER BALANCE GROUND-WATER FLUX AND STORAGE	X							
	53. SPRING ALGAL BLOOMS					X			
	54. ICE STUDIES				X				
	55. LANGRANGIAN CURRENT OBSERVATIONS						X		
	56. LAKE CIRCULATION						X		
	57. PHYTOPLANKTON NUTRIENT BIOASSAYS					X			
	58. TERRESTRIAL WATER BALANCE - RUNOFF	X							
	59. COASTAL CHAINS						X		
	60. PHYTOPLANKTON					X			
	61. SATELLITES - CLOUD, ICE, AND SURFACE TEMPERATURES		X		X		X		

Table 1. Tasks, projects, and water resources management problem areas (continued)

SYNTHESIS PROGRAM									
WATER QUALITY	X			X	X	X	X	X
WATER QUANTITY	X	X	X			X	X	X
OTHER ENVIRONMENTALLY SENSITIVE OPERATIONS		X		X		X	X	X

TASKS	PROJECTS	1. TERRESTRIAL WATER BALANCE	2. ATMOSPHERIC WATER BALANCE	3. EVAPORATION SYNTHESIS	4. LAKE HEAT BALANCE	5. LAKE CHEMISTRY AND BIOLOGY	6. WATER MOVEMENT	7. ATMOSPHERIC BOUNDARY LAYER	8. SIMULATION
62. WESTERN NEAR-SHORE BIOLOGY AND CHEMISTRY						X			
63. NCAR/DRI BUFFALO PROGRAM								X	
64. EUTROPHICATION MODELING									X
65. *CLADOPHORA* NUTRIENT BIOASSAY						X			
66. SEDIMENT OXYGEN DEMAND						X			
67. MAIN LAKE MACROBENTHOS						X			
68. HAZARDOUS CHEMICALS						X			
69. BASIN PRECIPITATION - LAND AND LAKE	X	X							
70. EVALUATION OF ERTS DATA	X								

Boundary Layer

The following intensive periods of observations have been conducted:

April 30 - May 14, 1972. Objective was to study the modification of turbulent warm air flowing over a cold body of water. Principal investigators were Brad Bean, Mark Donelan, Floyd Elder, Gordon McBean, and James Telford. Two aircraft, a fixed barge, lake towers, and several meteorological buoys were used during this period to obtain data.

June 11-24. Objective was to study lake-land breeze phenomenon and air mass modification. Strong synoptic flow prevailed during most of this period, however. Principal investigators were Brad Bean, Mark Donelan, Floyd Elder, Mariano Estoque, and Hans Panofsky. Two aircraft, lake and land towers, tethered balloons, a fixed barge, and meteorological buoys were used as observational platforms.

August 10-26. Objective was to obtain meteorological measurements of the atmospheric boundary layer when characterized by neutral stability. Principal investigators were Brad Bean, Mark Donelan, Floyd Elder, Gordon McBean, Mikio Miyake, and Hans Panofsky. Two aircraft, lake and land towers, a tethered balloon, a fixed barge, and meteorological buoys were used.

The data collected during these periods are being reduced and evaluated for analysis.

Synthesis Program

Five tasks relating to this program were identified in IFYGL Bulletin No. 3, and information is being gathered for three of these tasks.

Task 1 - Information Requirements of Great Lakes Water Resource Managers - has involved meetings with various groups undertaking planning and management studies and activities. The Great Lakes Basin Commission meeting on April 26 and 27 was attended for the presentation of conclusions and recommendations by Hydrosciences, Inc., resulting from their Limnological Systems Analysis Program. This covered the potential utility of models in each of 11 problem areas to assist planners and managers in their evaluation of alternative courses of action.

Information was also obtained from the series of Canada - United States Interuniversity Seminars on Institutional Arrangements for the Integrated Management of the Land and Water Resources of the Eastern Great Lakes.

The Great Lakes Basin Commission meeting on August 14 and 15 included presentations of the future program of the International Joint Commission on the Great Lakes, the Great Lakes Environmental Planning Study, including the next phase of the Limnological Systems Analysis Program, and the Navigation Season Extension Demonstration Program, as well as several other reports on environmental planning and management problems concerning the Great Lakes.

On Task 2 - Status of Knowledge Concerning Lake Ontario Limnology - data are being collected.

Under Task 3 - Preliminary "Quick-Look" Data Analysis - an automated system was developed for reviewing the performance of the buoy, tower, and land-station network and the major vessels' data acquisition systems. As a result of this effort, computer graphics are now produced weekly, showing time series plots of all sensors on each of these platforms. These have been reviewed each week at the IFYGL Rochester Field Headquarters to provide guidance for the servicing and maintenance of the buoy, tower, and land-station data acquisition system. The output consists of plots of each 6-min observation for each of 375 sensors in the system, with a week of observations appearing on one frame of microfilm. An example is shown in figure 2, where the water temperatures at the lake surface and 5, 10, and 15 m below the surface are plotted for one of the buoys. Points plotted above the top of the graphs indicate times when electronic calibrations were made on the system. Periods on the first and sixth days for which there are no traces indicate a malfunction somewhere in the data collection, communication, and computer processing system. Some of these missing data can be filled in from backup data storage tapes in the Rochester Control Center.

Similarly, for the two major U.S. vessels, a "quick-look" graphical display program has been prepared by which the raw data output from the ship sensors in a time series format can be examined. Additional software is being prepared to produce graphical displays of the vertical and horizontal diatribution of parameter values on successive observation periods ranging from 6-min to 12-hour intervals.

Task 4 - Data Analysis - will not begin until the primary editing and calibration of the data have been completed.

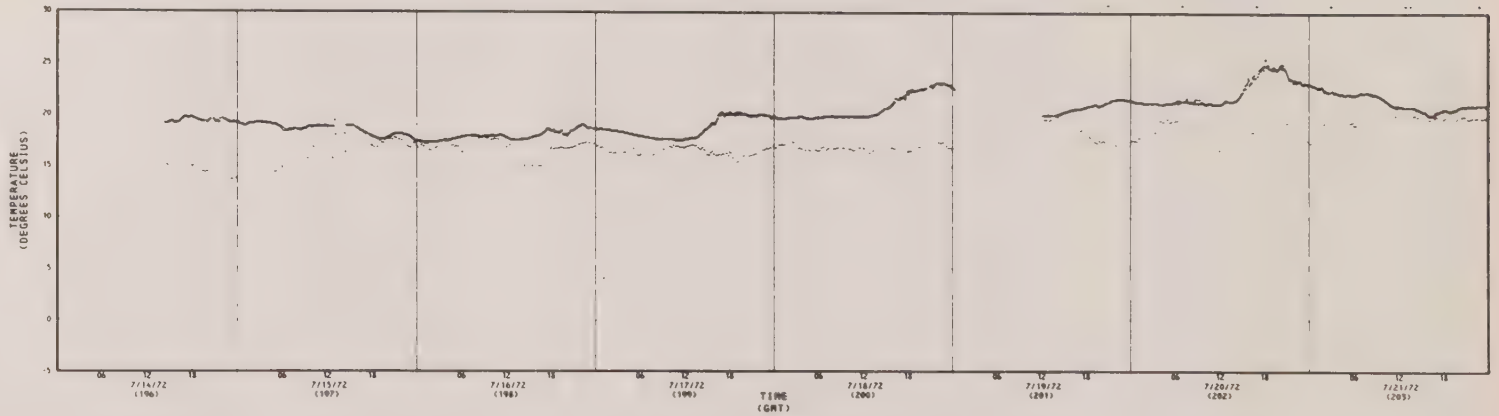
FRAME 69
PRELIMINARY DISPLAY (WORKING COPY) - DA ' MAY HAVE TO BE FURTHER TREATED.

COMPUTER GENERATED ON AUGUST 01, 1972

NOAA/IFYGL

EIGHT DAYS OF MEASUREMENTS OBTAINED AT 6 MINUTE INTERVALS - JULY 14, 1972 THRU JULY 21, 1972 - TIME GIVEN IN GMT.
TI STATION NUMBER 10 (INTERNATIONAL STATION LOCATION NUMBER 16, LATITUDE 43°27'23" N, LONGITUDE 77°44' 6" W), BUOY PLATFORM.

TI SENSOR POSITION 29, WATER TEMPERATURE AT LAKE SURFACE. LINE INTENSITY ——————
TI SENSOR POSITION 18, WATER TEMPERATURE AT 5 METERS BELOW SURFACE. LINE INTENSITY ——————



TI SENSOR POSITION 19, WATER TEMPERATURE AT 10 METERS BELOW SURFACE. LINE INTENSITY ——————
TI SENSOR POSITION 21, WATER TEMPERATURE AT 15 METERS BELOW SURFACE. LINE INTENSITY ——————

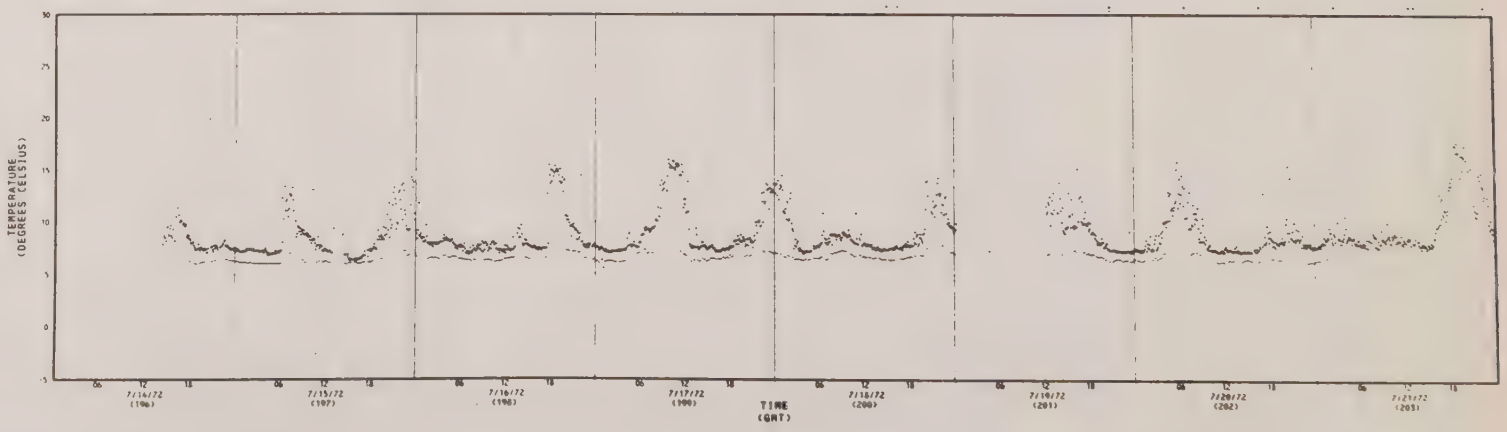


Figure 2. Sample of "quick-look" graphics.

U.S. Field Headquarters

The major U.S. observation systems are under the operational control of the U.S. Field Headquarters for IFYGL, located at 4800 Dewey Avenue, Rochester, N.Y. The Headquarters began full-scale operations on April 20. Captain Dewey Rushford, NOAA, replaced Captain Kenneth MacDonald as Director on June 15, 1972.

Ship Operations

The *Researcher* and the *Advance II* arrived April 26 and 28 and began operations May 1 and 3, respectively. The USCGS *Maple* commenced IFYGL operations May 6 and has since completed deployment of all observational platforms required of her. The *Shenehon* and the *Johnson* from the Lake Survey Center in Detroit arrived on the IFYGL scene April 28. The *Kaho* from the Bureau of Sport Fisheries and Wildlife and the *Dambach* and T-boat from the State University of New York at Oswego have been engaged in their respective program since early May. All vessels have been operating on schedule with only short periods of downtime for mechanical repairs. The U.S. Coast Guard has supplied personnel to aid in the Data Acquisition System (DAS) quality control aboard the vessels.

Shipboard Data Acquisition System (DAS)

The *Researcher* and *Advance II* IFYGL DAS's were installed before the ships left home ports in March 1972. The cruises from these ports to Rochester, N.Y., were used for shakedown of the DAS's. The ships arrived April 26 and 28, 1972, at the Monroe County Port of Authority dock facilities in Rochester. Data being recorded on the DAS have been sparse at times, leading to an estimated 50 percent acquisition of the physical data anticipated by the Technical Plan schedule. The water sampling for the biological and chemical studies is estimated at 70 percent of that planned. There have been several failures of the DAS's and associated sensors and sea cables. The most frequent outage has occurred aboard the *Researcher*, but many of the gaps can be filled by using the ship's on-board data acquisition system as a backup. "Quick-look" and quality check processing of the data has begun.

Aircraft Operations

During the first alert period (April 30 - May 13) the two aircraft that obtained measurements for the boundary layer experiments were the DC-6 (39C) from NOAA's Research Flight Facility (RFF) and the de Havilland Buffalo from the National Center for Atmospheric Research. Dr. Brad Bean and Dr. James Telford were the participating principal investigators.

On April 30, 1972, a meeting of the aircraft crews, principal scientists, and members of the Center for Experiment Design and Data Analysis (CEDDA) was held to decide on a gross schedule of activity. In addition to individual missions, it was agreed that several missions were to be conducted with two aircraft operating simultaneously at two different levels, forming box patterns with 3-min legs and drifting with the wind. The altitudes were to be 300 and 1,000 ft due to Doppler equipment limitations on the DC-6. The simultaneous two-level pattern was proposed by CEDDA in order to obtain the maximum amount of scientific information on modification of the air as it passes over the cold lake.

On the second mission (May 5) flight levels were 250 and 500 ft. The final simultaneous mission was flown at 600 and 1,200 ft.

Aircraft intercomparisons were flown on May 2 and 5 by the RFF 39C and the NCAR Buffalo. Tower flyby's were made for comparison with the Rochester deep water tower and the Niagara Bar towers; however, no data are available from the Rochester tower before May 12, and the Niagara Bar towers were not operational until 1800 GMT on May 13.

During the second alert period (June 11-24) the RFF 39C from NOAA's Research Flight Facility obtained measurements for the boundary layer experiment. Other aircraft operating during this period included:

(1) The NCAR Queen Air in support of the lake breeze study with Dr. Mariano Estoque as the principal investigator.

(2) A twin Beech aircraft D-18 from Aero Jet General Corporation, and a twin Bonanza from EG&G, for collection of background radiation data for the airborne snow reconnaissance tasks, with Dr. Eugene L. Peck as principal investigator. The EG&G aircraft will return sometime in September to fly all lines again.

(3) An Aztec C from Cornell Aeronautical Laboratory operating in support of the task on optical properties of Lake Ontario with Dr. Piech as the principal investigator.

(4) A C-47 from the University of Michigan, Willow Run Laboratories, with multichannel scanner and cameras mapping the shore line around the lake, with Dr. Fabian C. Polcyn as principal investigator.

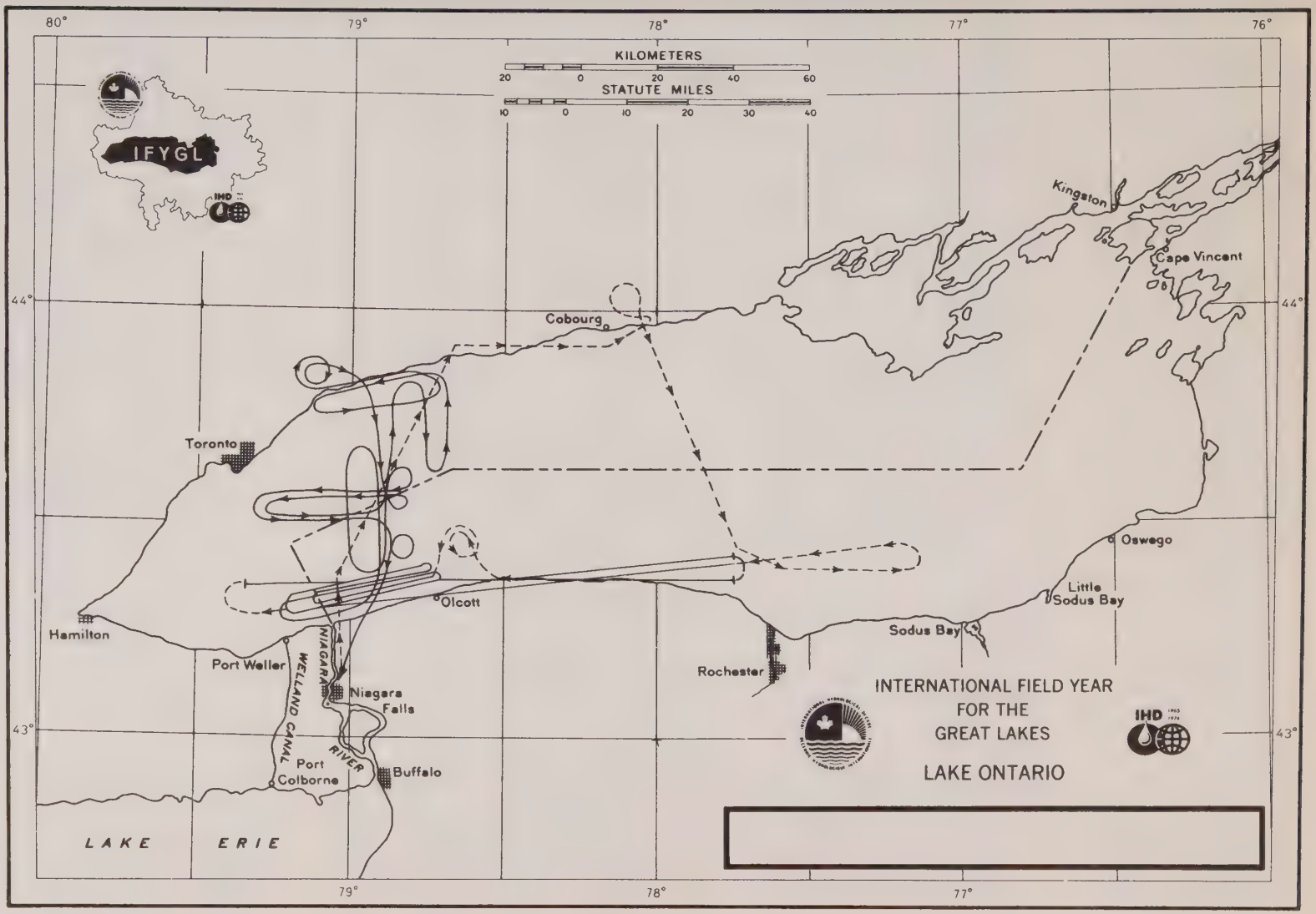


Figure 3. Mission flown by RFF DC-6 39C on August 13, 1972. Solid line indicates track along which data were obtained.

Prior to the flights of the RFF and NCAR aircraft, a meeting of the aircraft crews, principal scientists, members of CEDDA, and the Project Field Director and staff was held on June 11, 1972, to determine combined flight tracks and coordination procedures for several missions where the two aircraft would operate simultaneously at different levels, with NCAR flying perpendicular to the coast and RFF flying box patterns mainly parallel to the coast. The RFF was able to fly these supplemental patterns on June 12 and 16.

Flyby's by the RFF 39C over the Niagara Bar tower/instrumented site were scheduled every day the aircraft was in operation; however, only the following confirmed periods, where data were being recorded on the barge and the aircraft was making low-level passes, resulted:

June 16	1424 - 1515 GMT
June 20	1750 - 1820 GMT
June 24	1511 - 1643 GMT
June 24	1725 - 1914 GMT

At other times when the 39C was flying, the weather situation prevented operations of the Niagara Bar instruments.

Aircraft during the third alert period (August 11-26) included the RFF 39C and the NCAR Buffalo. A coordination meeting was held in the evening of August 10 to arrange procedures for intercomparison flights with the Niagara Bar tower system and a tethered balloon operation. The latter was conducted at a site on the mouth of the Welland Canal.

Flyby's by the 39C over the Niagara Bar tower were not conducted during this period due to limited availability of the aircraft and unsuitable weather conditions.

The NCAR Buffalo made flyby's on each mission during the week of August 21.

Radar Systems

Both the Buffalo and Oswego radar systems are now performing according to the program plan. The D/RADEX system on the Buffalo radar was operational only about 50 percent of the time during April, May, and June. Hardware, software, and personnel problems accounted for this loss of recorded data. Photographic coverage was nearly complete during the April-June period, but the quality of many of the pictures is poor. Several tapes made in July and August have errors that the computer is unable to read or pass. Without these tapes the percentage of coverage is only about 53 percent for these 2 months. It a method is found whereby errors can be skipped and the balance of the tapes read, this percentage should increase to about 80 percent.

During July, recorded data were lost for 2 weeks at Oswego due to a tape recorder malfunction. The radar was operational during the recorder downtime and the photographic coverage was complete. Efforts are being made to find an economical method of reducing the data from the 16-mm film record of precipitation during this period. At Oswego, an additional week of data was recorded in August at a nonstandard tape speed, and attempts are being made to recover these data; full photographic coverage was obtained. Other than during the 3-week period, the digitized record of precipitation at Oswego was about 98 percent complete.

Buoys, Towers, and Land Stations

Installation of the IFYGL physical data network, consisting of 20 stations, was completed on July 19, 1972. All land stations were on line by May 11, 1972, the towers by June 30, and the buoys by July 19. Data collection is 95 percent for the land stations and towers, and 70 percent for the buoys. More time than estimated was needed for initial calibration of the sensors. Some sensors were returned to the vendor for repair, resulting in a shortage of sensors for the last two buoys. Because of this, these two buoys were deployed over a month later, in July, than the first eight buoys, which were on line the second week of June.

After a couple months of experience, another boat was added (a total of two) for maintenance of the wet stations. This was needed to keep the stations on line and also for intercomparisons of sensors on station with a similar system installed on the *Johnson*. The intercomparison and the addition of the calibration laboratory at Rochester offers additional data for the quality control bank. Sensors from the physical data network are priority one for the laboratory schedule, but it is hoped that sensors from other users can be accommodated on a time-available basis. The laboratory is manned full time with an NOIC experienced technician. The reduction and analysis of data collected in the intercomparison and calibration laboratory is being done by a combination of contract and government personnel.

Rawinsonde System

As of this writing, with one exception, the rawinsonde operation will take place from mid-September to mid-December as agreed upon in joint Canadian-United States planning meetings on July 6 (AES Downsview) and July 25-26 (U.S. IFYGL Field Headquarters, Rochester). The exception is some alteration in the first intensive period and a temporary suspension of operations for 2 days due to an unavoidable shutdown of the east coast LORAN-C net for modification of the master station. Equipment, site preparation, and supplies are on schedule. At the planning meetings, these agreements of general interest were reached:

(1) Final drafts of the Standard Operating Procedures manual and Rawinsonde Recording Form were developed. These will be the basis for standardized procedures at all six stations, three Canadian and three United States.

(2) CMSgt. William Rummel, 6th Weather Squadron, USAF, will be the rawinsonde-net control officer, serving as the executive agent for the principal investigators (Ferguson and Rasmusson). Rummel will govern priorities for maintenance and implement future changes as necessary for uniform schedules and operating procedures at the six stations.

(3) Equipment installation and checkout will be done between September 1 and September 15, with net operations beginning September 16. During four intensive periods, eight flights per day will be made at all stations. These periods are September 22-26 (changed from September 20-24 because of LORAN-C shutdown), October 2-18, October 30-November 14, and November 21-December 7. Between these intensive periods, two flights at 0000 and 1200 GMT will be rade at all stations.

(4) The Canadian training course at Scarborough in late August was attended by key personnel of the USAF teams who will man the U.S. stations. This was a follow-up to the factory training conducted at Beuker's Laboratories.

(5) The large-bore mercurial AES secondary standard barometer at Toronto will be the standard to which all six station barometers will be referenced.

(6) VIZ factory calibrations of individual thermistors and hygristors will replace conventional baseline checks for IFYGL data reduction. Baseline checks will be made at 0000 and 1200 GMT observations as a rough check on the consistency of the factory calibrations. As far as is known, this is the first time this approach has been attempted in any rawinsonde program with United States or Canadian equipment.

(7) The Beukers software for data logging and real-time data monitoring was accepted. Trials at the Canadian Scarborough installation were vital in arriving at a suitable set of programs. Subsequent to the meeting, Beukers made some changes to conform the software to the SOP manual revisions imposed by representatives of the two governments.

(8) Near real-time data reduction will be made for the 0000 and 1200 GMT observations. Others will involve only data logging on magnetic tape for subsequent reduction by CEDDA.

EPA Water Chemistry Laboratory

The Rochester Field Office (RFO) of Region II of the Environmental Protection Agency has completed establishment of its office and laboratory at its newly occupied quarters at the University of Rochester, Hutchison Hall. As well as being the central EPA Water Chemistry Laboratory, the Office, headed by Ken Walker, administers and directs several IFYGL programs.

The chemical material balance program will be carried out under the direction of RFO IFYGL Branch Chief, Don Casey. This program will determine the amount and form of materials entering, residing, and leaving the main portion of Lake Ontario, with specific emphasis on plant nutrients. In cooperation with individual investigators, emphasis will also be given to near-shore processes and hazardous heavy metal movement in the environmental system. Special chemical material balance studies of Oswego harbor and the Rochester embayment will also be made.

RFO has the responsibility for chemical field sampling and analysis. Specific ion probes are used for in situ measurements of fluoride, chloride, and dissolved oxygen, while classical techniques are used for other observations. Chlorophyll measurements are being made by both fluorometric and spectrophotometric techniques.

Staffing of the EPA Water Chemistry Laboratory has recently been completed, with Mike Polito serving as director, and newly acquired personnel have finished their initial training phases on such instruments as the Technicon CM-6, Technicon AA II, Beckman Carbonaceous Analyzer, and Perkin Elmer Atomic Absorption Spectrophotometer.

After initial difficulties, mainly centering around nonfunctioning instrumental components, IFYGL samples are processed routinely. As of August 24, the following analyses, totaling over 23,000, had been completed:

Total Organic Carbon	756	
Ammonia Nitrogen	2,777	
Nitrate-Nitrite Nitrogen	2,966	
Fluoride	2,966	
Silicon Dioxide	2,966	
Nitrogen, Total Kjeldahl	1,539	
Phosphorus, Ortho	2,642	
Phosphorus, Total	484	
Chlorides	528	
Chlorophyll	1,479	
Calcium	531	
Magnesium	530	
Sodium	530	
Potassium	530	
Mercury	114	
Copper	282	
Nickel	282	
Zinc	223	
Manganese	114	
Iron	114	
Cadmium	282	
Chromium	315	
Lead	114	
Total		23,321

These chemical analyses not only support all chemical material balance calculations, but also such special projects as the spring algae bloom and *Cladophora* studies.

The interfacing of the automatic data processing system (Fluidyne interface-Wang computer printer system) to the Technicon AA II and CM-6 systems was recently completed. Automatic calculation of 60 percent of the laboratory-produced data should result. Computed data will go directly to disc storage, which will be interfaced so that direct transport to STORET is possible. Other data are being entered into STORET through the computer facilities at the University of Rochester.

The field and laboratory programs have established, and are actively participating in, a series of intercomparison studies with Canada, the EPA Analytical Quality Control Laboratory in Cincinnati, and NOAA. Statistical evaluation of the results of these studies is being carried out by A. Robertson, NOAA, Rockville, Md.

Activities are well into the International Field Year for the Great Lakes, with all systems on line.

DATA MANAGEMENT

Rochester Field Data Center

The Rochester Field Data Center is a focal point for documentation of, and information on, the major IFYGL systems and the data sets obtained with these systems. It also has the designed responsibility of processing requests for data from the major IFYGL systems and supplementary sources during the Field Year. Because of lack of adequate resources, however, the Center has not been able to provide investigators with as rapid access to the data as would be desirable. Of greater urgency has been to use both personnel and physical resources in taking all necessary steps to ensure careful documentation and calibration and to obtain data of highest possible quality for subsequent analysis and planning of future field experiments.

The above does not imply that requests for data are ignored, and it is believed that the efforts being made to monitor data for quality will provide users with a better product. In cases where delay in data availability would impose hardship on an investigator, the Center should be so notified, and every effort will be made to expedite the request.

Requests by U.S. principal investigators for both United States and Canadian data should be directed to the Rochester Field Data Center at least through December 15, 1972. After that date, all documents and the functions of the Center are expected to be transferred to the Center for Experiment Design and Data Analysis (CEDDA).

Investigators associated with a particular data collection effort will be asked in the near future to provide more exact details as to the availability, content, and validity of such data, in order to enable the Data Center to schedule resources for handling both temporary and permanent storage and for planning subsequent release and international exchange of these data. International data transfer schedules are being firmed up, and all possible efforts are being made to meet the requirements of all concerned. Direct international exchange of data among scientists is encouraged, but it is important that information concerning this type of exchange be provided to the Data Center via the monthly mailings of the Data Catalogue. Through the monthly mailings, the principal investigators have also been asked to identify their needs for secondary or standard data sets so that the data management team will be able to provide such data at minimum expense and with maximum efficiency.

Review graphics of conditional data sets are being distributed to investigators as directed by the U.S. IFYGL Project Office for identification of problems and for making these problems known to field operation and maintenance personnel. It is anticipated that updates of the graphics will yield data in an archive form to be used by investigators selecting data needed for special analytical studies.

IFYGL Data Catalogue

The Data Catalogue is designed as an inventory of data collection efforts to be updated monthly by individual principal investigators through responses to monthly mailings requesting program progress. These responses are improving each month and are of great importance to overall program management. They will later provide a tool for accessioning data by the Great Lakes Data Center. Currently, almost all programs are included and well described.

The first part of the monthly records is a calendar designed to provide information on parameters actually measured versus scheduled observations. For the benefit of those investigators who have not filled out this part of the monthly record, the method for doing so is as follows:

(a) Data management places an "x" on the calendar for each day on which the parameter is expected to be measured.

(b) If the parameter was measured on that day, the principal investigator should replace the "x" with "0" if observation was made at the frequency indicated.

(c) If only 90 percent of the anticipated measurements were made, the "x" should be replaced with "9" for that day. If no data were obtained, the "x" should be deleted.

By this procedure data management is kept informed of measurements made and of their extent. The latter provides a valuable tool for locating relatively continuous data for time-series and profile analyses. The record is incorporated into the next monthly updated mailing, giving the principal investigator an inventory of his efforts.

The second part of the monthly record provides space for the principal investigator to report on accomplishments, problems, and extraordinary occurrences. These comments are subsequently typed and retained as part of the historical documentation of each project for use by data management and in future analyses. They also provide input for the IFYGL Bulletin. In view of the importance of the monthly updates, investigators are encouraged to continue to provide as detailed information as possible.

At present, the Data Catalogue is being distributed in its entirety only to the data management groups of both countries. After the observational phase of the Field Year, the Catalogue will be published as a reference for sensors used and their location, parameters measured, errors, malfunctions, etc. Any investigator who desires information on the success of a project from which he hopes to obtain data can request a partial listing from his data management team before the Catalogue is published.

Data Quality Bulletins

As data reduction and analysis progress, some questions will arise concerning data quality. In view of the wide dissemination of these data, it is extremely important that data management be notified of problems encountered. Data Quality Bulletins will be issued and mailed to all principal investigators, outlining such problems, providing corrective procedures, and announcing availability of corrected data sets.

INTERCOMPARISON OF DATA ACQUISITION SYSTEMS ON U.S. IFYGL VESSELS

An intercomparison of the data acquisition systems on the U.S. IFYGL vessels was carried out in the vicinity of the deep water Texas Instruments tower off Braddock Point on August 17, 1972. The *Researcher*, *Advance II*, and *Shenehon*, and the T-boat from State University of New York at Oswego participated in this operation. The *Dambach* had been scheduled to participate but was forced to withdraw because of mechanical problems.

During the initial part of the operation, the *Shenehon*, *Advance II* and *Researcher* compared their continuous-recording meteorological data acquisition systems with the system on the Texas Instruments tower. The ships individually maneuvered around the tower so that they passed close to it on three passes - upwind, downwind, and crosswind. These three vessels then sailed on parallel courses 1/2 mi apart with their meteorological systems in operation to provide data for intercomparison of these systems.

In the afternoon the *Dambach* and the Oswego T-boat joined the three other vessels. All conducted BT casts while in proximity, and, except for the *Advance II*, also collected and interchanged water samples. These samples when analyzed will allow a comparison of the methods of water collection and analysis used for the samples from the different ships.

CALIBRATION, STANDARDIZATION, AND EVALUATION OF CHEMICAL ANALYSES

Two basic approaches are being taken in evaluating chemical analyses in the IFYGL program. Four main laboratories have systematic chemical analyses programs:

(1) EPA Water Chemistry Laboratory, Rochester

(2) CCIW Laboratory

(3) Ontario Department of the Environment Laboratory

(4) New York State Department of Environmental Conservation Laboratory

Each laboratory uses slightly different analyses methods and preservation techniques for water samples.

The first evaluation technique consists of a simple splitting of actual water samples collected from the main lake. These samples will be collected initially during the ship intercomparison on September 18 and then on the OOPS cruises to be made by the *Martin Karlsen* in October-November 1972 and January-March 1973. The normal shipboard analyses will be made on the *Martin Karlsen*. In addition, three sets of samples will be preserved by the normal methods used on the *Researcher*. These will be analyzed at a later date on board the *Martin Karlsen*, at the EPA Laboratory, and at the Ontario Department of the Environment Laboratory.

All preserved samples will be analyzed at approximately the same time. Split samples will be obtained at two stations, at each of which two hypolimnion and two epilimnion samples will be collected.

The second part of the intercomparison program will consist of analyzing a standard sample that is being prepared by EPA's AQC Laboratory in Cincinnati. The following laboratories will participate in analysis of the standard sample, which replicates as closely as possible the main lake water of Lake Ontario:

(1) EPA Laboratory, Rochester

(2) CCIW Laboratory

(3) Ontario Department of Environment Laboratory

(4) EPA Laboratory, Corvallis

(5) EPA Laboratory, Cincinnati

(6) New York State Department of Environmental Conservation Laboratory

(7) University of Wisconsin Water Chemistry Laboratory

The samples were shipped on August 28 to all the laboratories. Analyses will begin on September 11 and will be completed by September 15. Statistical evaluation of the results will be made by Dr. Andrew Robertson during the week of September 18-22. A report of his evaluation will be distributed to all participating laboratories, and a meeting to evaluate the analyses will be held shortly afterwards.

During August 1972, an intercomparison study of chlorophyll samples was initiated by AQCL, Biological Methods Branch, Cincinnati, for laboratories participating in the IFYGL Lake Ontario study. Reference chlorophyll samples were prepared in duplicate at two concentrations by AQCL, Cincinnati, and distributed to the following individuals:

Dr. Michael Mullin (EPA, Grosse Ile, Mich.)

Mr. Mike Polito (Director, EPA Laboratory, Rochester, N.Y.)

Dr. W.A. Glooschenko (CCIW, Burlington, Ontario)

Dr. G. Fred Lee (University of Wisconsin, Madison, Wis.)

Dr. Richard B. Moore (Director, Lake Ontario Environmental Laboratory, State University College, Oswego, N.Y.)

Dr. Eugene F. Stoermer (University of Michigan, Ann Arbor, Mich.)

Dr. Robert A. Sweeney (Director, Great Lakes Laboratory, State University College, Buffalo, N.Y.)

Mr. S. Salbach (Ontario Water Resources Commission, Toronto, Ontario)

It is anticipated that the results obtained from these laboratories will be correlated by using both spectrophotometric and fluorometric techniques. The analyses have been completed, and the results are now being examined by AQCL, Cincinnati.

FROM THE DESK OF THE U.S. COORDINATOR

For the information and guidance of scientists, the latest publications policy (approved by the IFYGL Steering Committee on June 13, 1972) follows:

IFYGL Publications Policy
(Second Edition)

General

The purpose of the publication policy for the International Field Year for the Great Lakes is to encourage prompt and widespread reporting of the results of individual Field Year projects, to ensure that adequate records are kept of project reports, to insure that descriptions of the methods and techniques used in the program are disseminated widely, and to ensure the preparation of comprehensive, integrated reports.

The policy envisages two major groupings of publications: (1) Project Reports and (2) IFYGL Publications.

Project Reports

Project Reports are defined here as all papers prepared to present the results of individual and related IFYGL projects. These reports may be comprehensive insofar as their projects are concerned, or confined to part of a particular project; and in general they will be prepared by the investigators who worked on the projects.

Those involved in IFYGL projects are free to publish Project Reports anywhere in the scientific or technical literature. Such reports should be published through regular channels available to scientists, or as required by contracts. It is considered appropriate that each Project Report carry an acknowledgement of the project's involvement in the Field Year. A suggested format for the acknowledgement is given in the Appendix to this policy statement.

IFYGL Publications

The following reports, to be known as IFYGL Publications, should be prepared and published to present Field Year activities.

1. *IFYGL Program Summary*

There should be a guidebook explaining IFYGL objectives, the overall program, how it was developed, and a list of data expected to be collected.

2. *IFYGL Scientific Reports*

A series of comprehensive scientific reports should be prepared on the major components of the IFYGL program and on the IFYGL program as a whole. Each of these reports should contain a section integrating the component tasks and relating the subject part of the program to the rest, and a section of concise, subject-oriented chapters covering the projects, objectives, and results of that part of the program.

One report should summarize the results of IFYGL in an integrated form.

3. *IFYGL Data Index*

A definitive index should be prepared listing the types of data, where they are stored, how they are stored, and how they may be obtained. The index should also include a bibliography of all publications related to the Field Year up to some arbitrary cut-off date.

4. *IFYGL Technical Manuals*

Technical manuals should be prepared to facilitate the standardization of data-collecting methods employed during the Field Year, and to provide a record of methods of data collection and performance.

5. *IFYGL Bulletin*

A periodic newsletter should be issued to inform participants in the Field Year of managerial and procedural practices and to disseminate general information regarding progress of the program.

Responsibilities

The responsibility for arranging for the preparation, technical, and editorial review and publication of IFYGL Publications lies with the Joint Management Team.

The Steering Committee, as representing the U.S. and Canadian National Committees for IHD, retains the responsibility for policy review.

Approved by the IFYGL Steering Committee

13 June 1972

Customs

United States and Canada are negotiating an official intergovernmental agreement to facilitate transit of personnel, material, and data over the borders.

We will provide participants with a copy of this agreement when it is ratified. In the meantime, the letters that follow should facilitate entry. An identification card will be available the week of September 18, 1972, as indicated in the third paragraph of Mr. MacDowall's letter.

File: 2200/5045

IFYGL Centre,
Canada Centre for Inland Waters,
P.O. Box 5050,
Burlington, Ontario.

September 5, 1972

TO: IFYGL Steering Committee

SUBJECT: CUSTOMS

The attached letter from the Southwestern Ontario Region would seem to meet our needs.

Please note particularly the last sentence of the second paragraph.

Individuals concerned should be identified as IFYGL participants and carry a document such as a letter from the Project Office or Coordinators.

Please notify the undersigned immediately if any problems arise so that further action can be taken.

J. MacDowall

c.c. C. J. Callahan
D. Rushford
T. Bryan
D. Drury
J. McCulloch
J. Sandilands
H. Ferguson

DEPARTMENT OF NATIONAL REVENUE
CUSTOMS AND EXCISE

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MINISTÈRE DU REVENU NATIONAL
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Mr. J. MacDowall,
Canadian Coordinator, IFYGL,
IFYGL Centre,
Canada Centre for Inland Waters,
P.O. Box 5050,
Burlington, Ontario.

P.O. Box 5940, Terminal "A",
London 12, Ontario.

August 30, 1972.

Dear Mr. MacDowall:

This will confirm our telephone conversation of yesterday's date concerning vehicles and equipment being temporarily imported by personnel of the International Field Year for the Great Lakes.

It is understood the purpose of the field year is to collect data and conduct surveys on the Great Lakes. In this regard, Collectors of Customs at Border Ports were requested in our letter of June 29, 1972, File L 8551-1-1, to admit goods for this purpose on a temporary permit without payment of security. You will, of course, appreciate it is not possible for us to notify Customs Ports each and every time individuals connected with the survey will be temporarily importing articles into Canada.

If you have any further questions in this regard, please do not hesitate to contact this office.

Yours truly,

J.V. Butler,
Operations Section,
Southwestern Ontario Region.

FILE		
No.		
DATE		
To	Initials	Date

INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES

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THE INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES

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IS AN OFFICIAL PARTICIPANT IN THE JOINT CANADIAN - UNITED STATES STUDY OF LAKE ONTARIO.

SIGNATURE OF BEARER:.....

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Joseph MacDowall, Canada
416-637-4308

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Cornelius J. Callahan, U.S.A.
301-496-8417

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